Subterranea

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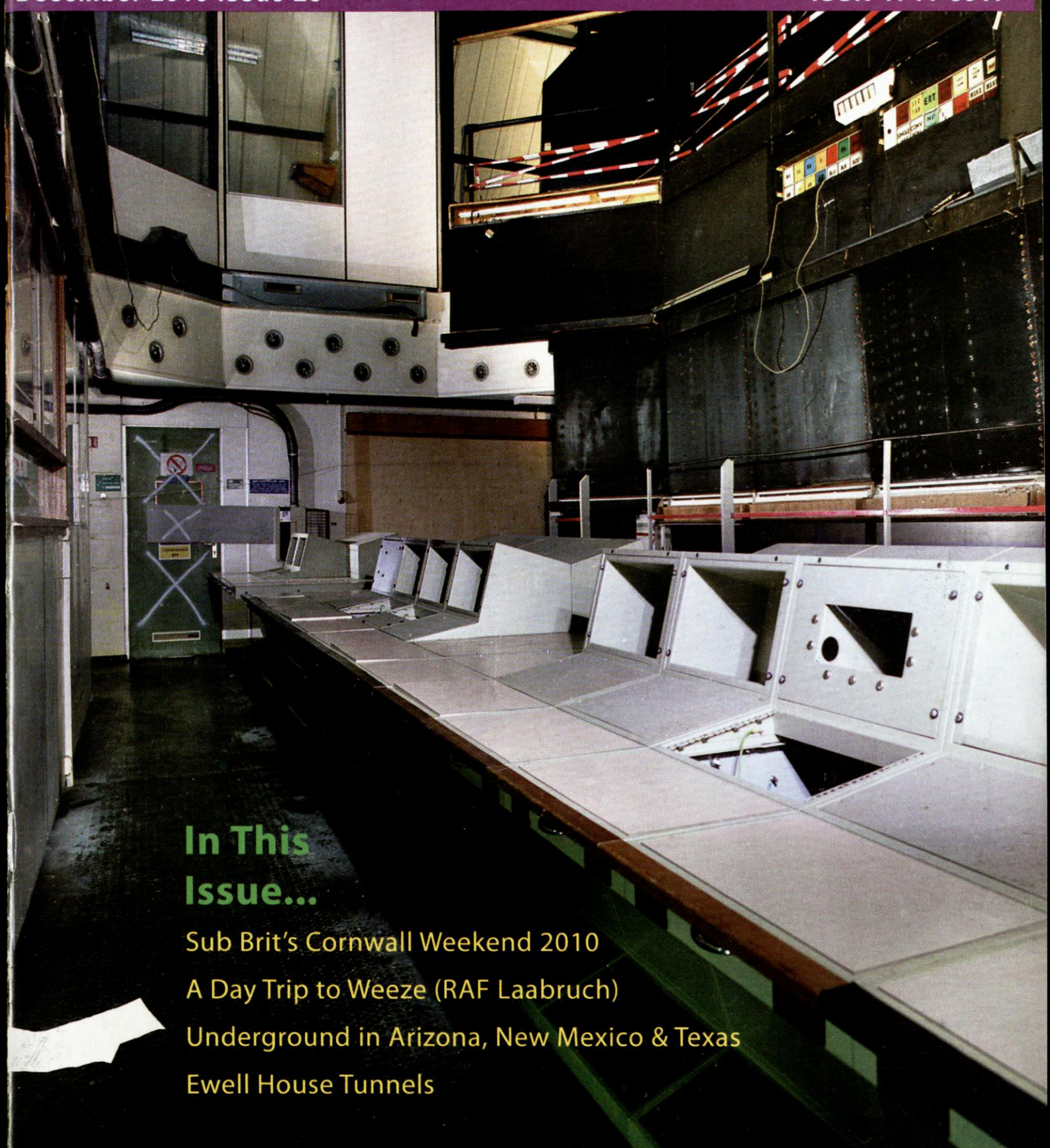

In This Issue...

Subterranea Britannica www.subbrit.org.uk

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. In the case of military structures studies are entirely confined to declassified and decommissioned structures. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Contents

Front cover photo: The two-level control room in the command centre at RAF Laabruch
Back upper: Steps down into the cold store at Ewell House
Above two photos by Nick Catford
Back lower: Titan Missile in its silo in Arizona. Photo Gavin Saxby

Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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Chairman's Welcome

Martin Dixon

The rescue of the 33 miners in Chile from their subterranean refuge was covered extensively by the media. What a pleasant change to see good news leading the headlines and what a bonus to see sympathetic treatment of our passion. I am sure we were all touched with emotion and impressed with the engineering in equal measure.

The rescue was an international effort with three rescue shafts being simultaneously excavated. The successful 'Plan B' was bored by a team from the United States; other countries who contributed to the effort included Australia and South Africa (who contributed to 'Plan A'), Canada (who led 'Plan C'), Austria (who provided the winching system) and various Far East countries who supplied communications equipment.

It is perhaps a telling commentary on the state of the British mining industry that the UK wasn't directly involved or called on. How refreshing to see the USA team take a back seat after their breakthrough, allowing the Chileans to take centre stage as their countrymen (and one Bolivian) emerged to a rapturous welcome. As agreed at our Autumn Meeting, I have written to the Chilean Mining Minister, Laurence Golborne, to pass on congratulations from everyone at Subterranea Britannica for their great achievement.

Just a few weeks later as this edition was going to press, hope turned to despair when 29 miners were killed in New Zealand at the Pike River mine. Two massive explosions reminded us of the hazards of the underground environment and of coal mines in particular. Our sympathies go out to the miners' relatives and friends. Let us all do our bit to ensure that future headlines are full of good rather than sad news.

Closer to home, this year has seen a record number of trips and visits organised by Sub Brit members. These have ranged from the well-subscribed weekends in Maastricht and Cornwall to smaller-scale visits to sites and museums across Europe. Sincere thanks to the many members who have organised these trips and opened up sites to new eyes; long may they continue.

When on a trip, do take every opportunity to publicise Sub Brit and perhaps leave a poster or encourage other enthusiasts to join our society. A write-up of any length about interesting sites is always welcome for publication in *Subterranea*, and editorial help can always be given if you feel you might need it.

Wishing you all a very Happy Christmas and good health and success in 2011.

chairman@subbrit.org.uk

SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events 2011

Sub Brit specific events

29 January SB Committee Meeting

9 April SB AGM & Spring Day Meeting, central London

1 March Deadline for Subterranea #26

19 March Hack Green open for SB members

Mid-April Subterranea #26 published

6 – 9 May SB Europe Visits weekend – Sweden

2 – 5 September SB UK Visits weekend – Manchester

15 October SB Autumn Day Meeting – venue tba

Other underground-related events

8 – 9 March "Fortifications at Risk" conference arranged by Fortress Study Group, Chelsea
http://www.fsgfort.com/FAR/FARsymposium.html

14 – 16 April "On the Surface: The Heritage of Mines and Mining" Innsbruck, Austria ctcc@leedsmet.ac.uk

16 April SERIAC Conference

14 May Hindhead Tunnel walkthrough

10 – 13 June Institute Europa Subterranea meeting, Valkenburg

29 July – 1 August NAMHO Conference & Visits, Shrewsbury

8 – 11 September Heritage Open Days across UK

17 – 18 September London Open House, including Paddock

For more information, email info@subbrit.co.uk or contact the Society concerned

Notes on the Committee Meeting held on Saturday 9 October 2010

SB Website

Martin Dixon (Chairman) said that the Sub Brit website had been in existence for many years and, although the content is invaluable, the design and functionality is becoming dated. Richard Seabrook has volunteered to 'refresh' the website, and the committee was able to review a demonstration of the proposed new site. Initially, the most noticeable change will be to the home page and accessibility to the site records, now using a map. A later facility will be for members to upload their own photos and information to the site, which will ensure that the website remains current. In parallel with this, it has been decided that the website should be transferred to a new host, and this will take place at the end of this year.

Charitable Status

The Charity Commission continues to consider our application for charitable status. We have answered a number of detailed questions about Sub Brit's activities.

Members' Questionnaire

The committee reviewed a draft questionnaire designed to provide information about members' interests, and what they want from Subterranea Britannica. This survey will be sent electronically to members, with paper copies going to those who are not on-line.

Site Directory

A new site directory, listing all underground sites open to the public (even if only occasionally), is currently being compiled. A printed copy will be sent to all members free of charge, with copies also available for sale to the public. Later, this information will be incorporated into the updated website.

Conferences

Tim Robinson reported that arrangements for the Autumn Meeting at High Wycombe had all been finalised. Attendance was likely to be slightly lower than previous years. The committee discussed plans for 2011, and agreed that the Spring Meeting & AGM would be held at Imperial College on Saturday 9 April, with the Autumn Meeting to be held on Saturday 15 October (provisional date). The autumn location will be decided once feedback is received from members through the questionnaire.

Visits

A large number of visits have been arranged this year, including a very successful weekend in Cornwall in September (this included a ten-minute interview with Martin Dixon on BBC Radio Cornwall). Nick Catford reported that interest in the forthcoming visit to Drakelow in November had been shown by a record 150 members, and a photographic workshop will be part of the visit. Many further visits are at the planning stage. The 2011 European 'Visits Weekend' will be held in and around Stockholm from 6 to 9 May. The UK weekend is provisionally set for Manchester from 2 to 5 September.

Treasurer

The committee agreed in principle to the purchase of a new accounting software package for use by the Treasurer to facilitate financial control.

Membership

Nick Catford reported that SB continues to have new people joining every month, and we now have well over 1,000 members.

Publications

Stocks of many back issues of *Subterranea, Siren* and other Sub Brit publications are now running low. The committee agreed that Hugh Ainsley should investigate the viability of making electronic versions available on CD for sale to members.

Next Committee Meeting

Will be held on 29 January, 2011. Members who wish to raise any matters for discussion should send details to the Secretary by 1 January, 2011.

Subterranean History !

Over the years, Sub Brit has published
many articles of interest in *Subterranea.*
Included in this issue is an
Index of Issues 1 to 10 of *Subterranea*
covering the period January 2003 to April 2006.
This will enable you to search for more about
your favourite sites – or those you have yet to explore.
Please contact publications@subbrit.org.uk
* if you wish to purchase any back numbers of Subterranea
* if you want a copy of the Index for Issues 11-20
(issued in Subterranea 22)
* if your copy of the Index 1-10 is missing and you need another.

NEWS – HEALTH AND SAFETY

Eleven-year-old girl dies in abandoned mine near Perranporth, Cornwall

An eleven-year-old girl, on holiday in Cornwall, died after wandering into an old mine adit whilst with her family exploring rock pools. The adit, at Droskyn Point near Perranporth, is accessible only at low tide. A short way into the adit she tumbled down a 10-metre deep shaft into water. Although rescued by other holidaymakers, she died after being airlifted to hospital.

SOURCE: ANON, 2010, Holiday girl killed in cliff fall named. *Daily Telegraph,* 14 August 2010, page 2.

NEWS – ARCHAEOLOGY

Neanderthal health and social care

Archaeological evidence from human skeletal remains has been interpreted as demonstrating that our 'cave-man' ancestors didn't simply discard their infirm or injured relatives as a waste of space, not to say resources. The remains of a half-blind person with deformed feet and withered arm are thought to demonstrate that he or she had been looked after for 20 years, despite his or her presumed inability to cope with hunting or house-keeping. No ancient mothers' or fathers' day cards have yet been reported though.

SOURCE: RADNEDGE, Aidan, 2010, Care was bedrock of caveman society. *Metro*, 6 October 2010, page 24.

Alderley Edge Landscape Project, Cheshire

The country around Alderley Edge, a sandstone ridge about 19 kilometres southwest of Manchester, is now a highly desirable residential area. The ridge itself is now largely owned by the National Trust.

Copper (and a little cobalt) was mined here from the 16th century onwards, and intensively in the 18th and 19th centuries. It has not been appreciated until recent years that mining here had its origins very much further back in time. Suggestions by an amateur archaeologist and members of the Derbyshire Caving Club that this was the case were at first discounted by mainstream archaeologists. Alan Garner had looked through a Victorian publication by one J.D. Sainter, 'Jottings of some geological, archaeological, botanical, ornithological and zoological rambles around Macclesfield" published in 1878. This contains an illustration of a wooden artefact which had been found in the mines among 'a heap of broken hammer stones.' Garner recalled seeing just that piece of timber hanging up in his infants' school classroom, and duly retrieved it. Museums at first rejected it as of no interest, but as a result of persistence it was eventually carbon-dated and proved to be of early Bronze Age date. Serious interest in the archaeology of Alderley Edge was redoubled when in 1995 members of Derbyshire Caving Club (who lease the mines from the National Trust) discovered underground a hoard of Roman coins dated AD 330 – 340.

Since then, a multi-disciplinary investigation of the site has been in progress, with publication by the Manchester University Press expected shortly. The evidence collected to date suggests three periods of mining. Early Bronze Age exploitation was followed, a couple of thousand years later, by some short-lived Roman activity, and then after another long gap by the modern mining of the last few centuries. Naturally, each new phase of mining has destroyed much of the earlier evidence, although significant surviving traces have been found.

SOURCE: CATLING, Chris, 2009, Alderley Edge Bronze Age mines. Magic and mining: the Alderley Edge Landscape Project. *Current Archaeology* 20(10), 22 – 31.

A deep black hole in the centre of Farnham Castle, Surrey

Farnham Castle, in west Surrey, is a 12th-century elaboration of an earlier structure. It is generally thought, although supporting evidence appears to be scanty, that the first Norman castles were timber palisades (subsequently replaced by stone walls) around the tops of built mounds, or mottes. David Graham's recent report on Farnham points out the potential problems of building stable heavy masonry structures founded on more or less unconsolidated material thrown up to form the motte.

Excavations in the late 1950s revealed the Farnham builders' solution to this problem. At the heart of the motte a massive three-metre square 14.5-metre deep hollow stone shaft was discovered, the base of which was found to be securely resting on solid chalk underneath the cast up material. As this shaft contains no doors or windows at any level, it appears never to have been intended as anything but a stable support for the masonry superstructure. And most if not all of its depth was buried by the motte materials being cast up around it, this evidently being the intention from the outset.

The then Ministry of Works decided to retain this mysterious deep black hole for public appreciation, and erected a concrete cap over the top, described as 'resembling a cross between a helicopter landing pad and the entrance to a Second World War bunker'.

Members of the public could descend onto a platform hanging in the top of the shaft and peer into the depths and speculate on the purpose of such a deep square black hole. Many may have thought it an oubliette, an unpleasant concept, involving the throwing-in of persons (perhaps still living) one wished to be rid of and to forget. But no skeletons have been reported from the bottom

David Graham's report concerns further investigation of the shaft. Little new has been revealed, although a detailed record of the internal walls has been made. The main aim of the recent exercise was to remove the concrete cap, considered inappropriate at the centre of the still-standing shell keep 12th-century masonry walls! The castle, and a view down the shaft, is open to the public without charge from 1 February to 24 December each year.

SOURCE: GRAHAM, David, 2010, Farnham Castle keep. Bull. Surrey Archaeological Society 423 (October 2010), 1 – 5.

Archaeological recording of 781 lead-lined coffins and their contents at St George's Church, Bloomsbury, London

During 2003 the contents of seven sealed vaults in the crypt of St George's Church, Bloomsbury Way, were removed, recorded, and relocated to an alternative burial place to allow a new use for the space. The Grade I Listed church was designed by Nicholas Hawksmoor and built between 1716 and 1732, with a stone exterior and unclad brickwork in the vaults.

Burials had been made in triple lead-lined coffins in the vaults in the years 1804 – 1856, after which they were sealed. The deceased were wealthy and professional middle-class people, many of them identifiable from coffin plates. 781 coffins and their contents were removed and recorded, generating a great deal of new data on late 18th-century lifestyles and early 19th-century funeral practices.

SOURCE: BOSTON, Ceridwen, Angela BOYLE, John GILL, and Annsofie WITKIN, 2009. 'In the vaults beneath': archaeological recording at St George's Church, Bloomsbury. Oxford Archaeology Monograph 8: xv + 234pp [ISBN 978-0-904220-53-7]

Elaborate Painted Tomb of Pharaoh Scribes Found, Egypt

A vividly decorated double tomb has been discovered in the necropolis of Saqqara, near Cairo. A 'vast cemetery' is suspected. Two false doors with paintings apparently depicting a father and son, interpreted as the chief royal scribes by archaeologist Abdel-Hakim Karar. Inscribed on one of the false doors was the name Pepi II, a pharaoh who reigned from 2278 to 2184 BC. The father's sarcophagus (or coffin) had been 'destroyed by humidity' and the son's had been robbed in antiquity.

SOURCE: ANON, 2010, Vividly-painted tomb of pharaoh scribes found. *The Guardian*, 9 July 2010, page 19.

NEWS – CONSERVATION AND HERITAGE

Subterranea Britannica contributions to the conservation of Britain's industrial heritage

In the last several years Paul Sowan has acted on behalf of English Heritage (charging neither fees nor expenses) as site archaeologist at the Betchworth and Brockham Limeworks and Hearthstone Mine sites, advising the Surrey Wildlife Trust, liaising with the retained architects and contractors, and recording archaeological features made accessible for the first time for many decades by the contractors' scaffolding. For three days in September he led public guided tours around the Brockham site as a contribution to the 2010 Heritage Open Days.

Further afield, he has been a member of a NAMHO group working on an English Heritage-commissioned Research Assessment and Research Framework for mineral extraction sites in England. This has meant attending meetings at Nenthead (Cumbria), Stiperstones (Shropshire) and Hawes (North Yorkshire), all challenges to a public transport devotee!

Silver sand mine below Nutley Hall public house in Reigate, Surrey

The *Nutley Hall*, a public house in Nutley Lane, northwest of Reigate town centre, has a small sand mine below it, with an entrance via steps down behind the bar. This is reflected in the pub's sign, which depicts a basket of sand being hauled up out of a shaft. So far as is known, the principal use of Reigate silver sand, mined in and around the town on a small industrial scale at several locations, was for glass-making at furnaces along the south bank of the Thames.

Reigate & Banstead Borough Council have given planning permission for the conversion of the public house to residential accommodation, although whether or not the permission will be implemented remains to be seen. A condition imposed with the permission is, as suggested by the Wealden Cave and Mine Society, that the sand mine and access to it should be preserved.

SOURCE: WEALDEN CAVE AND MINE SOCIETY, 2010, Planning application to convert the Nutley Hall to residential accommodation. *News of the Weald* 79, page 1.

Important lead mines remains to be protected at Grassington Moor, Yorkshire

Grassington Moor, to the north of the attractive village of that name, is littered with important relics of the former lead-mining industry, including shafts, stone-built cabins, spoil heaps, roadways, flues, and dams. These have been at risk if not in some cases seriously damaged in recent years by, for example, persons seeking stone for repairing roads. An English Heritage grant of £50,000 is to be applied to the preservation of about a square mile of the remains.

SOURCE: WAINWRIGHT, Martin, 2010, Yorkshire Dales lead mine site to be preserved. *The Guardian*, 5 August 2010, page 12.

NEWS – DEFENCE AND MILITARY

US nuclear deterrent 'out of action' for forty-five minutes

It has been reported that one ninth of the entire US arsenal of intercontinental ballistic missiles (with 50 nuclear warheads) was out of action for three quarters of an hour during Saturday 23 October as a result of a computer malfunction. It seems that 450 such missiles are deployed across North Dakota, Montana, and Wyoming.

SOURCE: ANON, 2010, No nuclear deterrent for 45 min. *Metro*, 28 October 2010, page 5.

Road builders in Poland move Nazi-era German bunker to make way for highway

Workers using two giant cranes have moved a Nazi-era German bunker weighing about 550 tons to make way for the construction of a highway in northern Poland. Piotr Rybicki, a construction overseer, said that great precision was needed to place the bunker on its new spot 50 yards (metres) from a highway under construction linking Warsaw and Gdansk, on the Baltic coast. The bunker is in the village of Witramowo.

The move, costing about 2 million zlotys (£500,000), came after a local official in charge of preserving historic buildings refused permission for dismantling the concrete bunker, built by Nazi Germany just before World War II. It was part of fortifications in what was then the German region of East Prussia.

SOURCE: *The Canadian Press* 4 November 2010

New use for the munitions store in Kensington Gardens, London

A redundant magazine in Kensington Gardens is to taken over by the Serpentine Gallery as additional display space, along with a café and (inevitably!) a shop.

Five minutes' walk from the existing Gallery, and just north of the Serpentine bridge, the magazine is a listed building, owned by the Royal Parks. Its core dates from 1765, and it was extended in the early 19th century when fear of an invasion by Napoleon was displaced by uneasiness concerning a possible civilian insurrection. Munitions were stored here until after the end of World War II. More recently it has been used to store flagpoles for the flags put up from time to time along The Mall.

SOURCE: BROWN, Mark, 2010, Serpentine gallery expands its arsenal with lease of historic munitions store. *The Guardian,* 2 November 2010, page 13.

A five-star WWII air-raid shelter in Croydon, Greater London

Selsdon Park Hotel, on the leafy outskirts of south London's mini New York, is a much extended historic mansion set in spacious grounds, popular with the rich and famous; it became an hotel in 1925. The local history society's archives contain an impressively illustrated and produced late 1930s brochure setting out the attractions of the establishment, and the room rates. You could have a double room with private bathroom in the summer months for from 14 to 20 guineas a week. Your servants could be boarded, elsewhere in the complex, for four guineas a week.

Tipped into this is a duplicated sheet, undated but evidently from 1939 or the early 1940s, worded as follows:

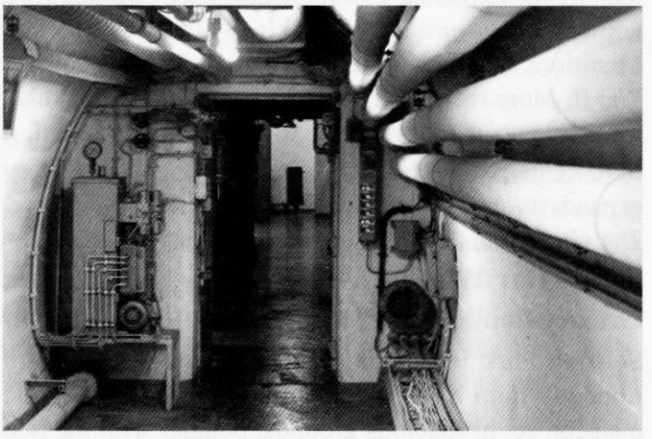
> **AIR RAID PRECAUTIONS**
>
> The Selsdon Park Hotel is not only in a neutral zone but it is situated in its own park of 230 acres remote from other buildings.
>
> There is available for the almost absolute security of residents a subterranean gas proof air raid shelter protected by four reinforced concrete floors with two entrances and, in addition, three emergency exits. Our architects report that in their opinion the roof of the air raid shelter is of such strength that it would withstand the demolition of the entire building above in the unlikely event of a direct hit. This shelter has a capacity of approximately double anticipated needs, and is furnished as far as possible on similar lines to the ordinary public rooms so that residents may be able to spend any times of danger under conditions of maximum comfort as well as safety.
>
> The shelter is adequately ventilated, has auxiliary lighting, lavatory accommodation and telephonic communication is available. In short, it is considered that the shelter is the best equipped and probably one of the safest in the entire country.

A cut above the run-of-the-mill shelters, then!

Presumably the shelter is below the latest (at the outbreak of war) extension, which had been added in 1935.

Paul Sowan, who lives nearby, is contacting the Hotel with a view to a possible visit.

Germany's secret Bundesbank bunker opens to the public



Part of West Germany's preparations for 'World War III' included the Bundesbank's creation of an emergency currency, called BBk-Serie II, which would theoretically restore stability if hyperinflation occurred in the event of a crisis. The bank stored 15 billion Deutsche Marks of this currency beneath a Bundesbank training and recreation centre, in a 9,000-square-metre bunker.

Officially called an air-raid shelter, construction took two years, but townspeople reported seeing items shipped there long after it was finished. The bunker's true purpose and contents remained a secret until October 2010 when local residents took the first tours of the bunker which has now opened to the public.

The bunker was constructed to accommodate up to 175 people for two weeks in the event of nuclear war. In addition to its own electricity generator, it has air-filtration and sewage systems, and an enormous tank of potable water. Delicate sensors also protected the money safe, sensitive enough to be set off by a train rumbling through a tunnel across the river.

But even police who guarded the bunker never knew what it contained; only three internal personnel – a supervisor, cleaning woman and technician – knew the top-secret information.

The key to the eight-tonne safe door deep inside the bunker was located at the Bundesbank in Frankfurt. In 1988, still before the fall of the Berlin Wall, the money was removed and destroyed for reasons that remain unclear. The Bundesbank continued to run its recreation centre there until 1994, when it was sold. Today the facility remains empty.

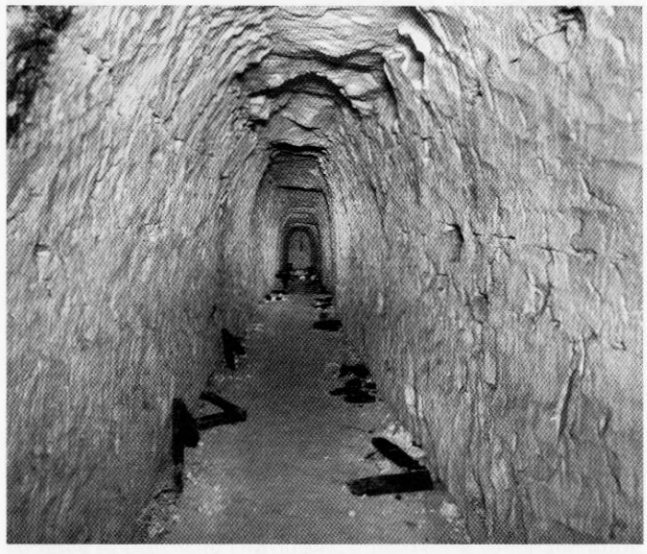
SOURCE: *The Local, Germany's News in English* 16 November 2010

World War I air-raid tunnelled shelter in Kent

Although air-raid shelters are generally thought of in terms of World War II, there were some in the previous World War. The Oxford English Dictionary cites the first recorded use of the term in 1919. German bombs were dropped from Zeppelins as far inland as Potters Bar, Herts and Croydon, south London, in 1915, but naturally the east Kent coast was rather more exposed to such enemy attacks.

The latest issue of the Newsletter of the Kent Underground Research Group reports recent investigations of two sets of tunnels excavated into the chalk of Ramsgate and Broadstairs, and includes also a reproduction of the front page of the 15 September 1917 edition of the *Thanet Advertiser and Echo*, with an illustrated article headed 'Cave dwellers of to-day'. Very encouragingly, the investigation was also featured on the front cover and as the lead article in the Winter issue of the Kent Archaeological Society's Newsletter: recognition of the importance of underground archaeology in the mainstream archaeological periodicals is always a welcome event.

Ellington Place, Ramsgate



One of the two parallel shelter tunnels, note the timber supports for benches. Photo: Nick Catford

The extensive World War II system of tunnelled air-raid shelters under Ramsgate, and its connection with the defunct Ramsgate Harbour railway tunnel, are of course well-known. But at Ellington School (TR 3723 6529), built in 1914 but now demolished, KURG members have recorded a small system of ARS tunnels, 1.3 metres wide and two metres high, and published a plan and section. Two parallel main tunnels and three cross tunnels linking them appear to have been accessed from three different entrances, identified as for use by boys, girls, and infants. Two shafts interpreted as sunk for spoil extraction. The report states that although this shelter is known to have been used in 1939 – 45, it was almost certainly also used in the earlier war as, by 1917, all Ramsgate schools had shelters.

All entrances to this shelter are now sealed, allowing new construction at surface at the site.

Lanthorne Road, Broadstairs

An accidental break-through into a cavity in Lanthorne Road has also been investigated. Voluminous earth fill prevented a thorough below-ground investigation at this site, which it is suggested was a small WWI shelter, perhaps associated with the former St Peter's Orphan and Convalescent Homes. The entrance has now been backfilled.

The 1917 local newspaper report

This includes a photograph (credited to the *Daily Mirror*) of an unlined chalk tunnel with what appear to be benches down each side. The text refers to this location as 'sleeping quarters', and ample accommodation for 'thousands of people'.

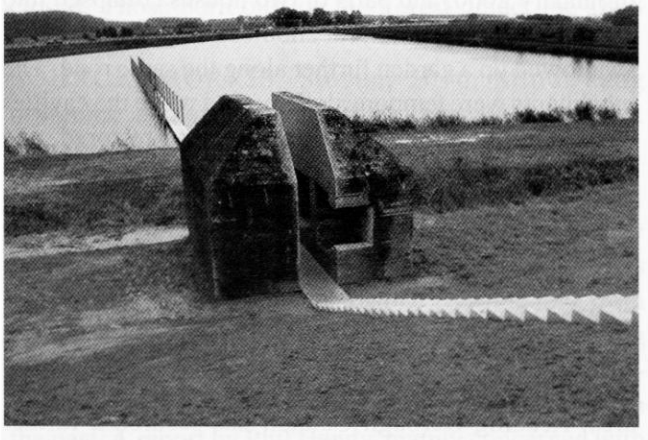
SOURCES:

ANON, 1917, Cave dwellers of today. *Thanet Advertiser and Echo*, 15 September 1917 [Reprinted in Newsl. Kent Underground Research Group 101 (August 2010), page 5.

ANON, 2010, Sheltering from the bombs: graffiti in Ramsgate tunnels. Newsletter Kent Archaeological Society 86 (Winter 2010), 1 – 3.

Le GEAR, Rodney F., 2010, Ellington Place, Ramsgate. Newsletter Kent Underground Research Group 101 (August 2010), 1 – 3 (including measured plan and section of AR shelter tunnels)

19th-century Military Bunker Transformed Into Waterside Landmark



An abandoned military bunker in The Netherlands has been transformed into a striking waterside landmark by Reitvel Landscape. Used from 1815 until 1940, the area in which the structure is settled was a strategic military zone protecting the cities of Muiden, Utrecht, Vreeswijk and Gorinchem by means of intentional flooding. Sitting atop ground near the water's edge, this seemingly indestructible bunker has been sliced open, revealing the heavy-duty yet miniscule interior. Both stoic and strangely beautiful, the segmented bunker forms a publicly-accessible attraction for visitors of the New Dutch Waterline.

SOURCE: Inhabitat web site 18 October 2010

Caves and military remains on Steep Holm Island, Bristol Channel, Somerset

Steep Holm, effectively a disconnected part of the Mendip Hills, lies in the Bristol Channel, just over five miles west of Weston-super-Mare. The island is managed by the Kenneth Allsop Memorial Trust, which coordinates the infrequent visits: for further information visit http://www.steepholm.org.uk . During the 1860s and again in World War II, Steep Holm, along with another island Flat Holm, formed part of the defences of the Bristol Channel, linking positions at Lavernock Point on the Welsh coast and Brean Down on the Somerset shore.

A group from Chelsea Speleological Society, and others, made the somewhat rough and surprisingly lengthy crossing in September, and spent a day on the island. There are several caves named (presumably natural), some of which appear to have been used by man (smuggling is mentioned, naturally). There are also, inevitably, extensive military remains, including 'dark and dank underground rooms .. bunkers and tunnels'. Steep and exposed flights of concrete steps lead down the cliffs in places to lookout stations and tiny mooring points.

It all sounds rather reminiscent of our visit to Inchkeith in the Firth of Forth during the SB Scottish study weekend a few years ago.

SOURCE: VOYSEY, Matt, 2010. Steep Holm, September 11, 2010, Newsletter Chelsea Speleological Society 51(10/11), 140–141.

A new class of Cold War field monument, near Freiberg, Saxony, former East Germany?

Freiberg, in Saxony (former East Germany, near Dresden) should not be confused with Freiburg (former West Germany, southwest of Stuttgart). Both places have had mining industries. In the course of attending a mining history conference at Freiberg (Saxony), former SB Chairman Paul Sowan noticed a curious feature during a field visit to an anciently and intensively mined area now deep in forest to the southeast of the city. The area is historically famous for silver mining.

There are many hundreds of fallen-in mine shafts throughout the forest, each with a ring or raised annular bank of shaft spoil around the top. Seen on plan, each of these shafts and spoil heaps looks like a hot-cross-bun! What might be taken to be four access points, each at ninety degrees to the next, have been cut through the rings of shaft spoil.

It was suggested that each spoil ring had been systematically sampled for possible uranium content during the Cold War. But that seemed to imply something like four cubic metres or so of dirt and stones from each of many hundreds of shafts, conjuring up visions of an enormous laboratory and vast quantities of chemicals to analyse such a huge mass of material. And surely, if uranium was sought, a simple probe with a Geiger counter

would have produced an answer without any need for all the digging? Simply transporting all the stuff out of a forest notably light on tracks suitable for wheeled vehicles looked a daunting task.

It might of course have been a search for other strategically important, but non-radioactive, metals, where bulk samples and chemical analysis would have been needed. Has anybody in the membership any relevant information, or bright ideas, what these 'hot-cross-bun' features in the forest might be telling us?

World War II secrets of Coleshill House, Oxfordshire

An auxiliary unit's hide in the grounds of Coleshill House that was used for training. Photo: Nick Catford

Coleshill House was the secret headquarters for the equally secret Auxiliary Units during World War II. Thousands of civilian volunteers, men and women, were trained here to fulfil the role of a resistance movement in the event of Britain being invaded by the Nazis. They were intended to lie low, wait for the invaders to pass them, and then wreak havoc amongst the enemy forces from the rear. None were really expected to live more than a week or two 'in service'.

At this Oxfordshire location near Faringdon the volunteers received training in guerrilla warfare, sabotage techniques, weapons handling, and survival skills. The forty-eight hours courses included training with explosives, and in unarmed combat. Murder was on the syllabus! At night the volunteers were transported out into the countryside, and left to find their own way back to base. An estimated 3,000 persons were trained, all sworn to the strictest secrecy concerning this little-known aspect of the UK's war effort.

Many of them took their secrets to their graves, although in recent years researchers such as Subterranea Britannica member Stewart Angell (in Sussex) have tracked down and interviewed survivors willing to talk, and discovered numbers of the very primitive underground lairs. His book is recommended.

An English Heritage Lottery Fund Grant is to be used to interpret the Coleshill site and its history to the public. Although the mansion itself was destroyed by fire shortly after the end of the war, a guardhouse survives, as does an 'underground operational base', both described as 'fragile'. The funding will be applied to repairs at the guardhouse, conservation of the underground works, and creation of a simulated underground base capable of withstanding expected visitor numbers. There will also be interpretation boards and other aids to allow visitors to understand the purpose of the site. Opening to the public is expected in 2012.

Volunteers are invited to assist the National Trust in the work, and Subterranea Britannica Chairman Martin Dixon will keep members informed of opportunities.

SOURCES:

NATIONAL TRUST, 2010 Secret wartime past revealed. National Trust *Newsletter*, Berks &c., Autumn 2010, page 8.

ANGELL, Stewart, 1996. The secret Sussex resistance 1940–1944.
Midhurst: Middleton Press: 85pp [ISBN 1-873793-82-0]

NEWS – MINES AND MINING

Further investigation of abandoned chalk mines, Reading, Berks

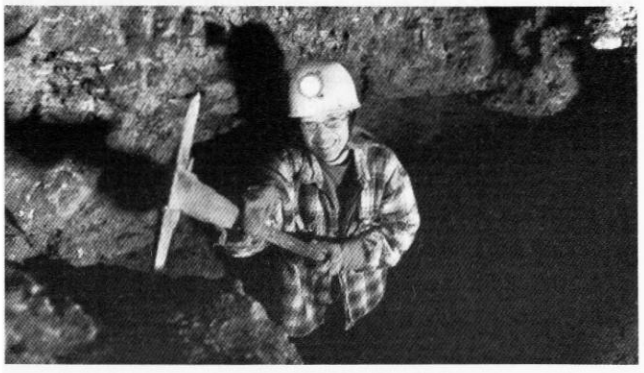
Ten years ago much of a street of houses, Field Road in the Coley district of western Reading, suffered severe damage as a result of subsidence into forgotten chalk mines. A fifteen-feet-deep crater opened up in the road in January 2000, and parts of two houses collapsed into it. In October the same year another crater, 26 feet deep, swallowed up a garden further along the same road. The inhabitants were temporarily relocated while the cavities were investigated and filled-up, the road restored, and the houses rebuilt.

The cavities all appear to be mines worked for chalk to incorporate into the brick-clays dug from surface deposits and used for brick-making. Chalk is mixed into the brick-clay to reduce shrinkage and distortion during firing.

There are strong suspicions that the area of mining, and potential ground instability, extends beyond the treated area. Reading Borough Council has secured a further £4.3m from the Homes and Communities Agency to pay for further investigations in the area, concentrating on the ground below another fifty houses in Castle Hill, Coley Place, Coley Hill, Dover Street, and parts of Field Road, Garnet Hill, Lower Field Road, Castle Crescent, and Mansfield Road. This will be Phase 3 of a, so far, continuing programme. Remote sensing is used, and boreholes drilled, down which cameras are lowered into any cavities discovered.

SOURCE: FORT, Linda, 2010, Hunt for chalk mines set to begin in 2011 +, Chalk mines: phase three of exploration to start 2011: site work to keep people safe. *GetReading*, 3 September 2010, pages 1 and 6.

Forest of Dean's first female Free Miner, Gloucestershire



Elaine Mormon has mined ochre (an iron-oxide mineral pigment) at Clearwell, in the Forest of Dean, for some years. The ochre, in various shades of brown, red, and orange, is used in paints and cosmetics. Two years or so ago, she decided to apply for 'free miner' status, under the terms of the Dean Forest (Mines) Act, 1838. To register as a 'free miner', the Act stipulates, a 'man' has to be aged at least 21, born and lived in the Forest, and worked in a mine for a year and a day. Four and a half thousand men have been registered since 1838. And Elaine Morton has now joined them, having succeeded in convincing the Forestry Commission that in the 21st century the word 'man' in this context should be regarded as including 'woman'.

In the longer term, there may be problems in registering further Free Miners, as the local maternity hospital has closed. Those born outside the Forest, under the 1838 Act, are not eligible.

SOURCE; MORRIS, Steven, 2010, Minor snag overcome as mother wins battle to become free miner. *The Guardian*, 7 October 2010, page 4.

Former metalliferous mining in the Orkney Islands

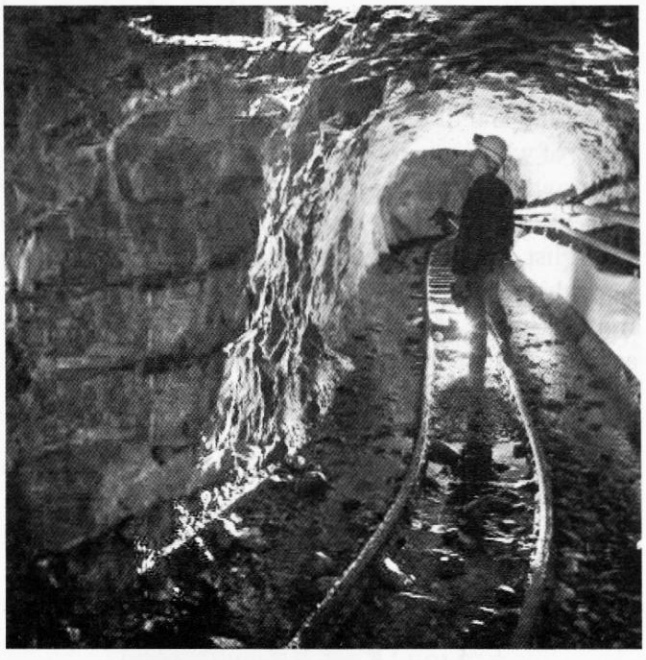
There are something like 65 islands in the Orkney archipelago. The main economic mineral exploited has undoubtedly been flaggy sandstone (presumably from opencast quarries) which has been used as a building material from prehistoric to modern times. But small-scale metalliferous mining has also been carried on in the past. A report by Phil Hendy, mainly concerned with the numerous sea caves at the foot of the coastal cliffs, notes also some locations for long-abandoned mines.

On South Ronaldsay, Graemsay, and Hoy, and also at Warbeth near Stromness, lead mining was carried out before 1800. There is said to have been a horizontal tunnelled mine entrance at the latter place, in the southwest of Mainland (the largest island). Copper is said to have been mined on Burray, and left infilled shafts or trials on Rousay. Traces of copper have been reported from Yesnaby. Iron and manganese were worked in the late 18th century on Hoy: the manganese supposedly from an ore body 200 feet down from the top of a 900-ft-high cliff!

Low grade uranium ore exists at depth below the islands, but not as an economically worthwhile resource for exploitation.

SOURCE: HENDY, Phil, 2010, Caves and mines of Orkney. Bull. Grampian Speleological Group , 4th Series, 4(4), pages 24 and 29 – 30.

Cononish gold mine application turned down



An application to redevelop a gold mine in the Loch Lomond National Park has been turned down. Scotgold Resources had been hoping to begin working the Cononish Mine, near Tyndrum, which was abandoned in 1997. They had applied to mine for gold and silver and build a processing plant on the surface, covering 39 hectares.

Dr Mike Cantlay, convener of the National Park Authority, said potential economic benefits could not be balanced against conservation concerns. He added: "The communities within the National Park are fundamental and this has been an especially difficult application to consider. There were compelling arguments from both sides. Our main concern lay with the design, scale and visual impact of the waste management facility which would hold 820,000 tonnes of slurry waste. At the end of the day, we could not balance the potential economic benefits against our primary aim to conserve and enhance our natural heritage, one of the original reasons for establishing National Parks in Scotland."

The site is known as a gold deposit but has never been commercially mined.

SOURCE: BBC News 18 August 2010

NEWS – MISCELLANEOUS

New Directory of underground sites

Roger Starling, our Secretary, is collating several members' entries for a forthcoming Directory of British underground sites visitable by the general public without formality. Publication is expected shortly.

Widening interests!

Subterranea Britannica, in its first years, was pre-occupied with more or less antiquarian topics such as 'secret tunnels' at castles and monasteries, grottos, ice-houses, and souterrains. All strictly subterranean. Paul Sowan, who has been an active member since our Society's second year, widened our scope to embrace canal, railway and road tunnels; and mines and subterranean quarries.

More recently we have pursued interests in military tunnelling and of course, notably, Cold War structures, many of which are not underground at all, although the windowless interior spaces are very much like subterranean spaces. Some of the sites, now off the secret list, might be thought of as 'underground' in the sense that, when built, they were intentionally kept secret from the public who paid for them! With hindsight, some aspects of the Cold War might be considered monumental follies (the notorious Protect and Survive booklet being a prime example).

The Folly Fellowship, similarly, seems to be widening its interests, in that it has featured in a recent issue of its newsletter, *Follies,* some of Britain's coastal sound mirrors. A folly, strictly defined, is created solely for the amusement of its creator or his guests, or perhaps sometimes the public at large. The sound mirrors, when built, had the perfectly serious purpose of detecting incoming enemy aircraft. They worked, up to a point, but were soon rendered redundant by the development of ever-faster aircraft, not to mention Hitler's V1 flying bombs and V2 supersonic rockets.

And Hitler's V3 London gun, or pump-gun, at Mimoyeques near Calais, might count as another military folly, as there is considered opinion to the effect that it wouldn't have worked, even if the RAF hadn't wrecked it with Tallboy bombs.

SOURCE: FAIRALL, Alastair, 2010, Sound mirrors II. *Follies* 20(1)(76), page 8 [This features the northeast coast mirrors at Boulby, Redcar, Sunderland, Kilnsea, Hartlepool, and Seaham.]

A little-known underground railway in West Norwood, south London

The stunning West Norwood Cemetery (a couple of minutes' walk from West Norwood Station) had two sets of catacombs. That for Anglicans was visited by several groups of Subterranea Britannica members during the last year. That below the former Dissenters' Chapel was modified to form part of a crematorium which, in 1955, was reconstructed on modern lines. The still accessible catacomb below the modern crematorium contains an interesting relic, namely a rail-mounted 'introducer', constructed to run on approximately metre-gauge track.

Introducers are used in modern crematoria to push each coffin into its allotted furnace. Disposable, flammable coffins are insisted on by crematoria for the very practical reason that manhandling a corpse into the red-hot interior of a cremation furnace would obviously be awkward, if not undignified. It is also potentially hazardous to the operators to push occupied coffins in by hand, as getting too close to the open furnace door is asking for trouble. Hence the 'introducer' which is a furnace-door-height trolley to carry the deceased and, in modern versions, a remotely controlled device to push the coffin into the chamber.

Furnaces are kept at full heat throughout the day, to save fuel, each adult corpse taking an average of around one and a quarter hours to be reduced to ashes. The hot ashes are raked out from the far end of the cremation chamber, allowed to cool, then mechanically pulverised before any metal implants are removed. Contrary to a popular urban myth, each cremation chamber can hold only a single coffin.

SOURCE: FENN, Colin, 2010, Cremation at Norwood: the catacomb railway. *Newsletter* Friends of West Norwood Cemetery 69 (September 2010), 11 – 14.

Tudor crypt rediscovered under church at Redgrave, Suffolk

Amateur actress Kathy Mills' act was more than expectedly dramatic during a rehearsal of Quasimodo for a forthcoming production at St Mary's Church, Redgrave, Suffolk in July. Dislodging a marble flagstone near the altar in the 14th-century church, she found her foot dangling in a brick vault. This is suspected to be a part of a lost crypt where coffins of the village's gentry were placed at various times in the last 500 years.

SOURCE: ANON, 2010, The bells, the bells! The secret crypt under the church floor? *Daily Telegraph*, 14 July 2010.

Visit report: a modern garden grotto and 'secret tunnel' at Hampton Court Castle, Hope-under-Dinmore, near Leominster, Herefordshire

Hampton Court Castle (Herefordshire) is at SO 520524, on the south side of the A417 road about half a kilometre east of its junction with the A49. Both the castle and the gardens and grounds are regularly open to the public.

The subterranean interest is in the beautifully kept gardens. From the ticket office-cum-souvenir shop the visitor walks through a series of brick arches through formal walled gardens. Straight ahead what appears to be a tunnel portal leads in fact into a 'wisteria tunnel' and not underground. However, a diversion to the right before that point is reached leads visitors into a maze beyond which, if successfully negotiated, you can ascend to the roof of a 'prospect tower' (built in 1998) and enjoy watching people coming after you trying to find their way through.

Steps down from the bottom of the tower lead into an almost unlit curving masonry-lined tunnel, with one or two glazed skylights to avert total darkness. Water is heard at the far end, and you emerge into a tiny thatched

gazebo overlooking a very attractive sunken garden. Turning left here, you progress underground again though a grotto, passing briefly behind a waterfall through which the garden can be seen again, then back underground again and eventually surfacing at the far end of the sunken garden.

The sunken garden was created in 1864, but by 1996 had been neglected and part-filled with refuse. The estate's owners have restored it, and created a very agreeable modern version of an 18th-century grotto, secret tunnel, prospect tower and maze.

The gardens have been open to the public since 2000, and the house since 2009. Details can be found at www.hamptoncourt.org.uk or by email from office@hamptoncourt.org.uk.

Subterranean house extensions in Belgravia, London

Burrowing additional rooms below expensive London houses remains in the news. Nigella Lawson and her husband Charles Saatchi have protested against the proposal of neighbours in Eaton Square for a 'cavernous basement' under a back garden. Massive disruption is feared, as skip after skip is delivered for the removal of excavated soil. There is also a ground stability question.

At nearby Chester Row a filled skip recently fell through the roadway into a void resulting from a basement conversion and/or expansion. A Westminster Council spokesman has been quoted as saying that 'We see no need to deprive our residents of the opportunity of extending their properties', and it is expected that the latest application for planning permission will be granted, whether the well-heeled neighbours want to live on a 'permanent building site' or not.

SOURCE: BAR-HILLEL, Mira, and Jonathan PRYNN, 2010, After the scaffolding, the diggers are next as Saatchi joins basement wars. *Evening Standard,* 18 October 2010, page 3.

Down (underground) in Ilford, London

Christopher and Jane Cremer, in Ilford, have added a 30-square metres underground room to their four-bedroom terrace house ... under the back garden. It is about 20 metres from the rear of the house, so it appears did not need planning permission. Entrance is down steps from the lawn, and there are skylights to let in natural daylight. Inside, the extra room is comfortably furnished, and provided with a sauna and shower room. The cost is reported to have been £55,000, whereas an extra room below the house would have been around £140,000. An estate agent has suggested the new room adds £100,000 to the value of the property.

SOURCE: McGHIE, Caroline, 2010. Dig deep to find some extra space. A subterranean extension in the garden is the latest idea for more room. *Daily Telegraph* Property, 2 October 2010, page 7.

A modern underground eco-house in Cheltenham, Gloucestershire

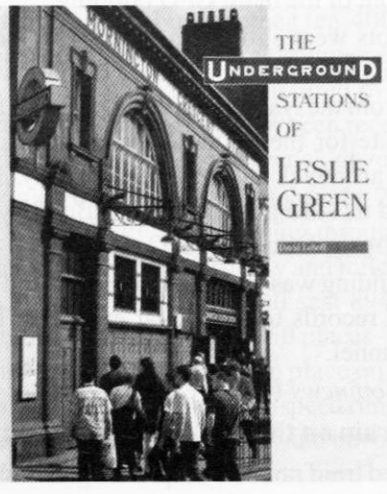
Zoe and Tim Bawtree have created a sub-surface house in Cheltenham. The rooms, seemingly all on one floor, are all below ground level, but lit by daylight from skylights. Heating comes free from a 56-metre deep borehole using a ground source heat pump. This works by pumping ethylene glycol (better known to most people as antifreeze) down the hole, where it somehow gains a useful amount of heat, and using this heat when it comes back up again for underfloor heating.

The house may have been expensive to build (£345,000) but is claimed to be very cheap to run. There is no gas supply, so no gas bills. And electricity bills vary between £20 and £40 each month.

SOURCE: MIDDLETON, Christopher, 2010. Watt lies beneath? Dirt-cheap energy. *Daily Telegraph* Property, 17 July 2010, page P5.

NEWS – PUBLICATIONS – BOOKS

Leslie Green's Underground stations, London



The architect Leslie William Green [1875–1908] was engaged in 1903 to design stations for three of London's deep tube railways, now forming parts of the Bakerloo, Northern, and Piccadilly Lines. By 1907 he had been responsible for over thirty new stations, almost all of which are characterised by their ox-blood red tiled street-level buildings (Regents Park station has never had a surface building).

David Leboff's book describes and illustrates the 25 stations still in use which remain more or less intact as Green designed them, along with six more which remain intact at least at street level but are closed (Aldwych, Brompton Road, Down Street, Euston, South Kentish Town, and York Road). Details are also given for twelve other Green stations where original features have been partly or entirely replaced. The emphasis throughout the book is the appearance of the public parts of the stations, both at street level and in the subsurface corridors and platforms.

The three deep tube lines for which Green designed stations were, of course, masterminded by the rogue American financier Charles Tyson Yerkes [1837–1905] for whom some details were published in *Subterranea* 19 (2008), pages 10–11.

DETAILS: LEBOFF, David, 2002. *The Underground Stations of Leslie Green*. Harrow Weald: Capital Transport Publishing: 96pp [ISBN 1-85414-255-0]

NEWS – TUNNELS AND TUNNELLING

200-year-old tunnel found in Mumbai

A tunnel thought to be 200 years old has been unearthed in the premises of the General Post Office in south Mumbai. Believed to be an ancient escape route, the tunnel heads towards Colaba in south Mumbai. The tunnel is twenty feet below the ground, full of mud but in surprisingly good condition. The Archaeological Survey of India (ASI) is assessing the discovery. Covered under a cement structure with a heavy iron lid and huge flowerpots placed on it, the tunnel was discovered in the garden in front of the main GPO building.

When the pots were shifted and the lid was opened, it revealed a rusted iron ladder leading below. Some claim it could be from the Napoleonic era and could have been a escape route for the British garrisons stationed here who feared an attack by the French Army. Napoleon was defeated in 1815 and the famous Bombay Fort was demolished by the British in 1862.

The GPO building was built between 1904 and 1913, but there are no records to show that engineers had come across the tunnel.

SOURCE: *Topinews* (website) 20 November 2010

Runaway train on the London Underground

An unmanned train ran non-stop through six stations on the London Underground early in the morning of 13 August 2010. Other trains were steered clear of the rogue maintenance train during its 13-minute journey, starting at Archway station on the southbound Northern Line, and ending at Warren Street.

SOURCE: ANON, 2010. Tube cleared for runaway train. *Daily Telegraph* 14 August 2010, page 2.

New electrical cable tunnel from Hackney via Kensal Green and Willesden to Wimbledon, London

Costain has won a £200m contract to dig a new high-voltage cable tunnel for National Power. This will run from Hackney via Kensal Green to Willesden, and from Kensal Green to Wimbledon, thus adding yet another to the numerous tunnels under the River Thames. Construction should be complete by the end of 2014.

SOURCE: COSTAIN, 2010. Costain to dig 20-mile tunnel. *Daily Telegraph* 19 October 2010.

A new Thames Tunnel, with a difference, London

There are, by now, numerous tunnels under the River Thames: railway and road tunnels, pedestrian tunnels, and services and cable tunnels, all crossing under the water from one bank to the other.

But now quite a different tunnel is planned, a sewer following the course of the river most of the way from Hammersmith, through central London, to Beckton, downstream from the Thames Barrier, but deep below it.

This new tunnel will commence in London Clay, a splendid and watertight tunnelling medium. It will then traverse the tricky Lambeth Beds and Thanet Sand, from near Wandsworth to near (but well below) Waterloo Station: these beds in part tend to behave as waterlogged quicksands, making tunnelling challenging. Eastwards from here the tunnel will be in flinty chalk full of water-filled fissures: lumps of very hard flint embedded in the soft chalk can be expected to cause rapid wear of the tunnel boring machine's cutting teeth.

In dry weather London's existing sewers (many of which were the work during the years 1858–75 of Joseph William Bazalgette [1819–1891]) cope with the greatly increased volume of London's waste and foul water. But after prolonged and heavy rain, the flow is so swollen that the existing sewers cannot take it all to the down-river sewage treatment works. The excess, admittedly diluted but containing raw sewage, is discharged into the Thames at numerous points through central London.

The new deep-level sewer is intended to convey all sewerage and all storm water away from the city, to be pumped back up to ground level for treatment. Construction, subject to all necessary consents, is expected to take from 2013 to 2020. This will be the most ambitious tunnelling operation in London since the boring of the London Ring Main for Thames Water.

Architects' proposals for new uses for the Kingsway Tram Tunnel, London

Looking south along the Kingsway tram tunnel towards Holborn station. Photo: Nick Catford

The northern entrance to the former Kingsway tram tunnel (Listed Grade II) can be seen in the middle of the road, behind iron gates and railings. Tramlines are still in place on the ramp down which, until London's trams were abolished in the 1950s, double-deckers would glide into the darkness below. There were two subterranean public tram stops within the tunnel, with raised passenger platforms, and the vehicles emerged back into daylight below Waterloo Bridge.

The southern end of the tunnel has since been re-engineered as an underground road bypassing Aldwych, and the remainder has from time to time been used for a variety of storage and control centre purposes.

An exhibition, 'Forgotten Spaces', organised with commercial partners by the Royal Institute of British Architects, recently featured two proposals for imaginative reuse of the extant tram tunnel, or at least its north portal. An illustrated brochure (accompanying an exhibition display at various locations around the capital) was published explaining the various suggestions, including the two subterranean ones featured here and several others.

Architect Scott Brownrigg's suggestion is to fill the 52-metre-long northern ramp area, open to the sky, with water to form a public swimming-pool. As the ramp slopes at 1 in 10, water depths suitable for all abilities are included. Walkways and sunbathing areas alongside the pool are envisaged. A huge plate-glass panel would seal the tunnel entrance, allowing divers to peer into the partially lit but unused tunnel.

Whether the sun-bathers would enjoy Kingsway's traffic fumes, and how the water would be kept clear of crisp packets, is not stated! This seems a fun idea, but not very likely to be implemented, at least until Kingsway is designated a pedestrians-only space. But the exhibition brochure includes some nice 'before and after' illustrations.

An alternative idea is credited to the JAIA architectural practice. This envisages a restored pedestrian walkway and subterranean market, with an entrance direct from Holborn Station (eliminating perhaps the hazardous matter of crossing the northbound or southbound traffic flows up and down Kingsway). There might also be an 'event space' for performers (somewhere out of the rain for those guys who haunt Covent Garden perhaps?) and a plaza for meetings and exhibitions.

SOURCE: ROYAL INSTITUTE OF BRITISH ARCHITECTS, 2010, *Forgotten spaces*. London: RIBA: 32pp.

Eurotunnel: the Germans have arrived!

A Deutsche Bahn ICE3 train has been sighted at London St Pancras International. This was a test run by the German railways authority, with a view to introducing through services to and from Köln and Frankfurt-am-Main, alongside the present Brussels and Paris trains operated by Eurostar (well, actually, the trains will be one behind the other for safety reasons). Services to Frankfurt could commence in 2013. London to Köln is expected to take less than four hours by through train, and London to Frankfurt just over five hours. These are, of course, city centre to city centre timings.

SOURCES:

The Guardian, 20 October 2010, page 8; *Metro*, 20 October 2010, page 51.

FORD, Roger, 2010, Eurostar order ignites Franco-German conflict. Ministers and Alstom try to reverse 'wrong kind of trains' decision. *Modern Railways* 67(746), 18–19.

Eurotunnel: Eurostar services developments

Eurostar has, since 1994, operated the through passenger trains between London, Brussels and Paris (and occasionally a couple of other French destinations). The Channel Tunnel, operated by Eurotunnel, also accommodates short-haul shuttle trains from the English to the French coast conveying road vehicles.

Eurostar is to refurbish its existing fleet of 28 international passenger trains, and buy another ten 400-metre long trains capable of speeds up to 320 kilometres (200 miles) per hour. These are to be manufactured by the German firm Siemens, news which has not been received well by the French firm Alstom or the French government!

The new trains will be equipped to run on 25 kv AC, 1.5 / 3.0 kv DC and 15 kv AC, allowing through running in the several countries they currently and might in prospect serve. Each of the new trains will seat 894 passengers, as against the current vehicles' 750 places. There is now modern rail track infrastructure in place on both sides of the English Channel to allow high-speed running between the three capitals currently served, and beyond. However, through journey times from London have been quoted as Paris (just over two hours), Amsterdam (under four hours) and Geneva (under five hours). Eurostar advertisements in the British newspapers in October 2010 gave current London to Köln (Cologne) journey times, changing trains in Brussels, as four hours 11 minutes.

SOURCES:

Eurostar to buy 10 new trains. *Modern Railways* 67(746), page 6.

FORD, Roger, 2010, Eurostar order ignites Franco-German conflict. Ministers and Alstom try to reverse 'wrong kind of trains' decision. *Modern Railways* 67(746), 18–19.

Smoke in tunnel under the Thames halts Eurostar international trains

Lineside fires in the HS1 tunnel under the Thames between Stratford International and Ebbsfleet Stations on 8 July 2010 led to tunnel closure for several hours. Eurostar passenger trains to and from Brussels and Paris, and South Eastern Mainline trains to and from east Kent were delayed. Some Eurostar trains were sent back to

St Pancras. Regrettably, as with the recent train failures under the Channel, Eurostar personnel were found wanting, or sometimes not found at all, leaving numerous dissatisfied ticket-holders unable to complete their journeys as planned.

SOURCE: ANON, 2010, Smoke in tunnel hits Eurostar. *Modern Railways* 67(743), page 9.

Reopening of tunnels from Great Malvern Station to a former hotel, Worcestershire

Two sealed tunnels have been reopened at Great Malvern Station. They were created to link the station with the former Imperial Hotel (now a girls' boarding school). The first tunnel runs from the down platform into the former hotel basement, where the end is blocked, presumably by the school, 'allegedly to stop boys getting into the girls' dormitories'.

The tunnel was originally made to give direct access from the station to the hotel for first-class passengers and their luggage (and presumably for their flunkies to carry the same). As this tunnel is known locally as 'the Worm' it may, perhaps, not be dead straight?

The second tunnel, currently accessed only from the school end (at a lower level than the hotel end of tunnel 1), is reportedly a 'goods tunnel' with its own spur from the down line, and a turntable, and was to allow goods wagons to be run directly into the basement. Its lineside portal and wooden doorway can still be seen from trains as they enter the station.

To mark the well-preserved station's 150th anniversary, the Railway Heritage Trust has offered £150,000 to restore the 'Worm' provided this sum is matched from other sources, and a sustainable long-term management plan can be evolved.

SOURCE: ANON, 2010. Malvern's 'Worm' could be restored. *Railway Magazine,* October 2010.

Gotthard base tunnel holed through, Switzerland

The 35-mile Gotthard base tunnel, linking the main railway networks of Germany, Switzerland and Italy, was first proposed in 1947. It is intended to form a short-cut and much faster rail route between German, Swiss and Italian cities than the existing nine-and-a-quarter mile St Gotthard railway tunnel driven, at a greater altitude, in 1872–1880. The new tunnel, although now holed-through, is far from completed, as track, power supply, safety, signalling and ventilation equipment all need to be installed. Train services through the new route are expected to commence in 2017, with international trains running at 155 mph.

SOURCES:

ANON, 2010, Rock and hole: Swiss complete boring project. *The Guardian* 16 October 2010, page 33.

ANON, 2010, 35-mile longest tunnel. *The Sun* 16 October 2010, page 14.

Subterranean Britain - Cold War Bunkers

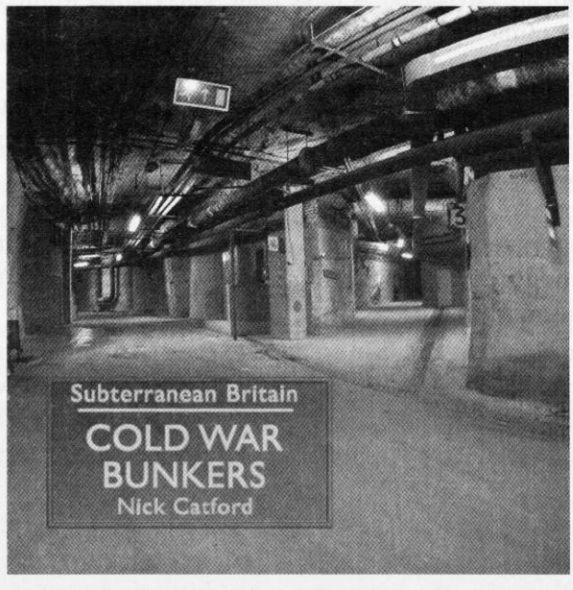
Book review by Andrew Smith

Nearly all of us take pictures of underground sites, be they bunkers, caves, tunnels or other subterranean folly – but how many of us actually do something with those images. Many place pictures on publically accessible websites but Sub Brit Membership Secretary and former professional photographer has gone one step further and published his own book containing the most detailed photographic study of the bunkers of Great Britain, ever.

Neatly divided into sections covering each type of the principal types of bunker in the UK, this hardback, photograph-rich, coffee table book provides a comprehensive study of everything from the Utility bunkers to a Royal Observer Corps post. A section also covers Civil Defence on the Channel Islands.

Unsurprisingly, there is an extensive feature on the 'Holy Grail' of bunkers – the former Central Government War Headquarters beneath Corsham in Wiltshire. From Wick in Scotland to Hope Cove in Devon, I hate to think of the number of miles Nick clocked up covering the length and breadth of the country.

Those familiar with Nick's work will know that his photography is of the highest level and the images in this book don't disappoint. The images cover everything from plant rooms to blast doors, Elsan toilets to emergency exits.



The final section of the book looks briefly at a small selection of private bunkers.

Without doubt this is a very comprehensive picture essay of some of the finest bunkers in the UK, including a number that are now demolished or converted to other uses such as private residences. A worthy addition to any book collection and high on my Christmas list!

DETAILS: CATFORD, Nick, 2010. *Subterranean Britain – Cold War Bunkers*: Folly Books: 224pp [ISBN 978-0956440525]

This book can be ordered through the Sub Brit website.

Cornish Mining and More

Sub Brit's Annual Visits Weekend: Cornwall, September 2010

By Linda Bartlett and Paul Sowan

Given the richness of the underground heritage in Cornwall, we thought it was about time that Sub Brit had one of its annual weekend of visits in the county. So not a difficult decision, but the hard part was trying to get a programme which would be representative of the available sites and to make sure we didn't have to travel too much. Martin & I put together a wish list of sites, and then contacted Kevin Baker, the current chairman of NAMHO, who then helped us put these into a sensible order, and made the arrangements with the site owners. To this, we added a few sites of our own – making a very packed weekend! Luckily, Kevin was able to be with us for the weekend, giving us more information about the sites as we toured round.

Friday 3 September

West Cornwall is a long way from London, and even further from much of the rest of Great Britain. Paul reports that he elected to travel down to Penzance on the sleeper. The *Cornish Riviera* is a remarkably affordable and comfortable option, and excellent value for money, leaving London Paddington at 23.45 and arriving at Penzance (getting on for 300 miles later) at 8.00 the next morning. It was a beautiful morning at the end of the line, boding well for the weekend (misleadingly, as it turned out).

The longest journey was undertaken by Martin Briscoe who drove (not in one day!) 642 miles each way from Fort William. On Friday morning, Martin and I explored Falmouth's Pendennis Castle with Martin Briscoe – an attractive English Heritage preserved fortress, with a few underground passages, casemates and dungeons; while Sue Monsell and Brian Hillman went down Poldark Mine.

The Sub Brit party at RAF Drytree. Photo: Martin Briscoe

The Rendezvous

For the first event of the Sub Brit weekend, we'd arranged a visit to the Camborne School of Mines test mine, at Carwynnen. Kevin advised us that this was difficult to find, so we arranged to meet at King Edward Mine on Friday afternoon. There were 45 attendees for the overall weekend, and luckily 39 of us were able to make this visit. Most of us learnt a valuable lesson: don't rely totally on your sat navs to get you to the right place when you put in a rural postcode – you need to look at the map as well, to see the precise location! Still, we all got to the rendezvous eventually – and shuffled cars to form a convoy to the test mine.

Geology

The geology of Cornwall (and west Devon) is very different to that of most of the rest of England. It is dominated by upland areas formed of the igneous rock granite intruded, whilst very hot and fluid, into older sedimentary and volcanic rocks which have been more or less metamorphosed and mineralised as a result. Counting the Dartmoor granite, in Devon, and the offshore Scilly Isles, there are six major granite intrusions, formed from 300 to 270 million years ago. From east to west they are the Dartmoor, Bodmin Moor, Hensbarrow, Carnmenellis, Land's End and Scilly Isles granite.

The metamorphosed and mineralised folded Devonian and Carboniferous strata intruded by the granite are in Cornwall referred to as *Killas*. Metalliferous ores, mainly of copper and tin, occur and have been mined mostly in the Killas immediately bordering the granite, with small amounts in the granite itself. Our mining-related visits took in sites on the margins of the Land's End, Carnmenellis, and Hensbarrow granites near, respectively, Zennor and St Just; Camborne and Redruth; and St Austell.

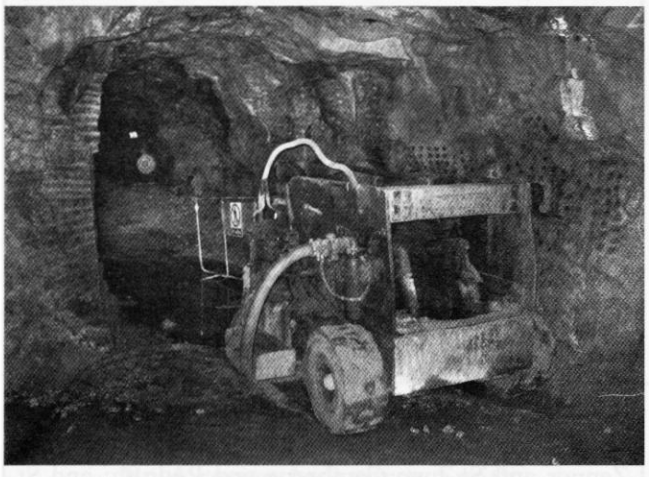
The Lizard peninsula, on the south Cornish coast, is in part of much older metamorphic rocks of Pre-Cambrian age (more than around 600 million years), noted especially for the small-scale quarrying of serpentine for ornamental purposes.

When the masses of granite cooled and crystallised they were still deep underground. Millions of years of erosion have now (partially) revealed them at the surface. It is likely that the six visible granite masses are simply the tops of an enormous single intrusion at depth. Feldspar, one of the three main minerals in granite, is decomposed by air and water, turning into the clay mineral kaolin (china clay), Cornwall's most important export.

It is still relatively hot at depth below Cornwall, on account of residual heat from the granite or heat generated by radioactivity – uranium ore (mostly pitchblende, a uranium oxide) occurs in small amounts in the igneous rock. Two consequences of this follow. It is thought to be economically feasible to extract geothermal energy by pumping cold water down boreholes, and extracting it later when it is hot and therefore useful for space heating and so forth. The downside is that the radioactive gas radon is very much in evidence throughout Cornwall, with implications for public health.

Camborne School of Mines Test Mine – formerly Holman's Test Mine

There are two large walk-in entrances to a 'mine' from which no marketable ore has ever been produced! This is a set of roomy passages almost all on one level, driven in granite. Only with luck and the eye of faith might you spot a speck of copper or tin ore. It was established by Holman Brothers Ltd by extending an opencast granite quarry underground, its purpose being the trialling and demonstration of the company's mining equipment, especially rock drills. Consequently, the most striking impression underground is the huge number of holes drilled in the granite walls. John and James Holman had patented a rock drill in 1881, which won worldwide recognition as 'the Cornish rock drill', the manufacture and export of which was a very successful enterprise.



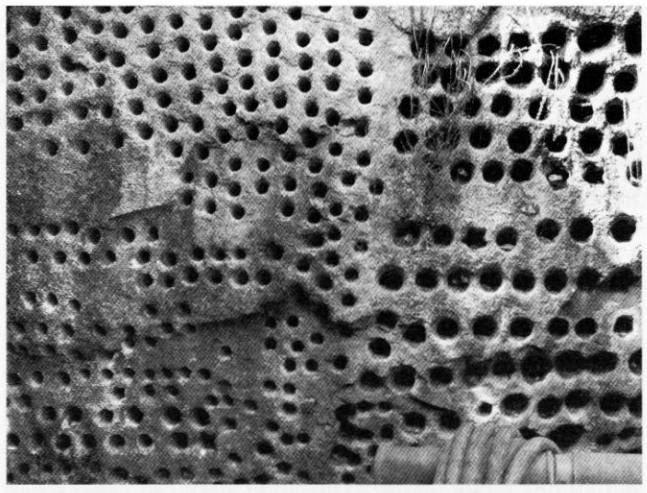
Machinery in the Camborne School of Mines (former Holman Brothers) Test Mine. Photo: Roger Starling

Holmans were merged into another company, which removed its operations elsewhere in 2003, since which time the Camborne School of Mines has used the caverns as the last of a series of three training mines they have operated. Earlier ones were at King Edward and South Condurrow mines closer to Camborne.

The attraction of this location for training novice miners is the solidity and stability of the rock. In real production mining, there is often a possibility of hitting bad ground, and maybe floodwater. Here beginners can be trained in safety in surveying, drilling, blasting, mucking-out, etc. The mine is also used as a location for research projects such as the development of seismic monitoring devices, and remotely controlled vehicles.

At one or two points there are departures from the level floor, as miners need to sink shafts and excavate rises, and equip the latter with conveyors and so forth, so we had a short excursion 'upstairs' into a higher level.

This was an exceptionally well-chosen first site, as it ensured we all had a first-hand look at fresh granite, and its mineral constituents, from the inside. And granite, of course, was a key part of the story of most of the rest of the sites to be visited. We are grateful to Gus Williams, the Mine Captain, for a most excellent tour.



Evidence of the thousands of test and demonstration drill holes made at the former Holman Brothers' Test Mine at Carwynnen. Photo: Roger Starling

Going out with a Bang!

The visit ended with a look at a face set up ready for blasting, with wired-up detonators in very precisely located shot-holes. The importance of millisecond delays and the charge-hole pattern was explained. The climax of the visit was an unexpected treat. Our attention was directed to an innocuous bit of pink plastic tube. Gus had rigged up a demo of an explosives test. He'd set a charge of 20 grammes of explosive – just in the open, not within the rock. Having rigged up the detonator, we all gathered at the far end of the passageway and I (Linda) was asked to push the button to fire the charge. WHUMPH !! a big bang and then the shock wave and its echoes hit us – tremendous, and as I said, a real treat.

At the end of the visit, we piled back in our cars, still smiling from the experience, and set off to the Tremough campus of the University of Exeter at Falmouth (yet more challenges for people relying on sat navs – but our SB signs helped a bit). We handed out the Information Packs for the weekend and allocated rooms.

Nearly all of us opted for the University evening meal – not a brilliant choice in retrospect, as it was catering-standard fish & chips and not very cheap. Perhaps the chocolate pudding and custard made up for it a bit. But the saving grace was a chance to mingle with the 45 Sub Britters attending for the weekend – and the bar was open! The Association for Industrial Archaeology were also holding their conference here, so old friends from both societies had a welcome excuse to catch up with news and support the bar, where a local real ale called Betty Scroggins (or something like that) proved most acceptable. Networking with the AIA people was quite a 'plus' for the weekend.

Saturday 4 September

Our chariots for the day arrived on time – two small coaches, so that we could navigate the narrow Cornish roads.

Cornish Engines at Pool (NGR SW 672415)

There must once have been hundreds of Cornish Engine houses scattered across the county. Now there are probably less than one hundred, and very few of these have their engines intact. The engines at Pool were originally powered by high-pressure steam boilers introduced by local hero Richard Trevithick. We saw two engine houses this morning, both opened specially for us by the National Trust. The smaller Engine House for Mitchell's Shaft had its 1887 winding engine running – sadly not in steam but at least we could see the power and the energy.

East Pool and Agar Mine in May 1995. Photo: Nick Catford

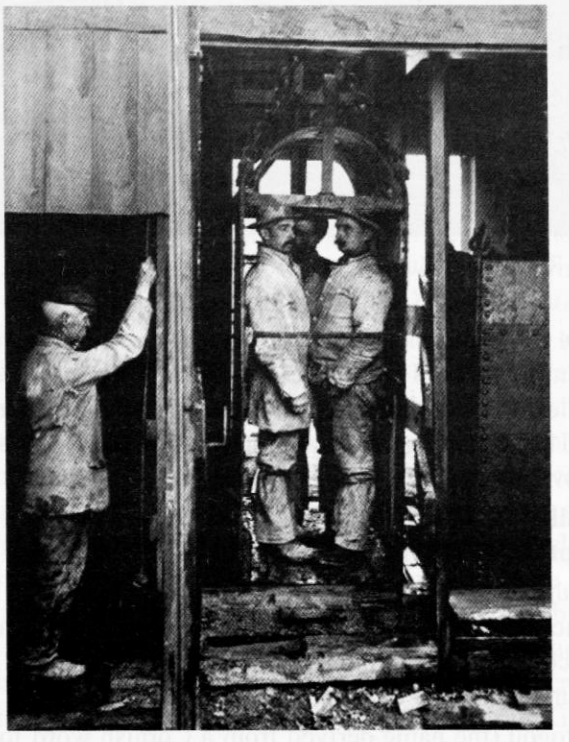
Then we did a quick swap over by mini-bus and had a chance to look round the second mine complex, behind the Morrisons car park. This was set out more as a museum, with more of the various sheds and outbuildings associated with the mine. Taylor's Shaft still exists here, though roped off and not accessible. Again we had a chance to climb up though the engine house to look at the massive 52-ton beam of the engine. We were also able to see various mining exhibits, including explanations of the 'Man Engine' (see later panel). All very nicely preserved.

Back on the minibuses, we set off to the next site via the town of Camborne. This was so that we could pick up the pasties we had ordered for our lunch.

King Edward Mine in 1905

King Edward Mine (NGR SW 663388)

The Museum includes surface buildings and plant from a mine to which there is now no access below ground. But what there is to see above ground is impressive and is the result of years of first-class work by volunteers. King Edward Mine Ltd, the site management company, has on its Board of Directors representatives of the Carn Brea Mining Society, the Trevithick Society, and the King Edward Mine Preservation Group, and is supported by Cornwall County Council.

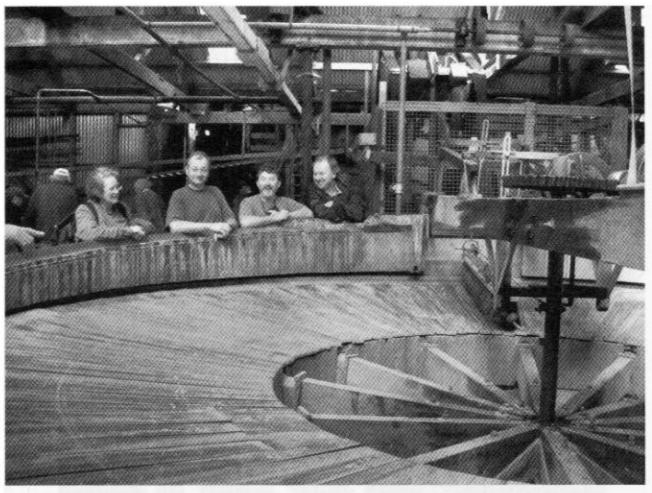


Descending into the King Edward Mine in 1903

This is the oldest complete mine site surviving in Cornwall. All its building are Listed Grade II*. The underground workings, formerly part of South Condurrow Mine, were abandoned in 1890, but reopened in 1907 by the Camborne School of Mines under its new name. Edward VII had become King of England on the death of his mother, Queen Victoria, in 1901.

The mine was operated as a fully operational training mine from 1907 to 1970. It was envisaged that the sale of tin produced would cover most of the operating costs. Ore extraction ceased at the start of World War I, but was recommenced in 1920. However, the following year saw the closure of the adjoining and interconnected Grenville mine, and the cessation of pumping, leading to the lower parts of both mines being flooded. Development as a museum dates from 1987.

Displays range from traditional glass cases of artefacts to an atmospheric fully equipped tin ore-processing works, where some of the somewhat Heath Robinson-style equipment (to the eye of the uninformed layman) could be seen in motion. Many of the items of specialised machinery are excessively rare examples and, in some instances, unique survivors. There is an impressively well-stocked bookshop. Information on King Edward Mine can be found at www.kingedwardmine.co.uk.



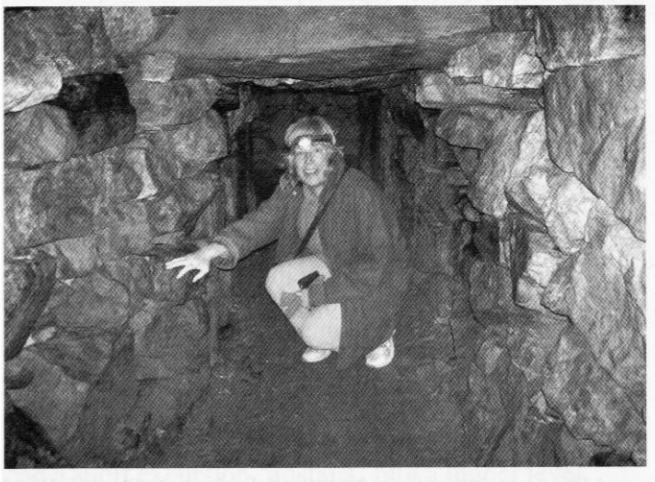
Roundframe (used for concentrating very fine tin ore) in the mill at King Edward Mine. Photo: Martin Dixon

The morning ended with a self-service pasty lunch in the lecture room of the museum, with the pasties we'd collected en route to the mine and whose warm smells had been enticing us all morning. The Museum staff also provided us with teas and coffees – very welcome.

Halliggye Fogou – Saturday afternoon 4 September (NGR SW 714239)

At this attractive site we had the benefit of member Mike Stace's recollections of exploring the district, and discovery of this enigmatic subterranean tunnel in his younger days (he grew up in Falmouth).

A fogou (the name derived from a Cornish word for a cave) is usually a blind-ended cut-and-cover tunnel of prehistoric date, with stone-built side walls and a flagstone ceiling. They appear to be characteristic of the western fringes of Europe – especially Brittany, Cornwall, Ireland, and Scotland. The innermost end is often rendered difficult of access by the deliberate provision of a low 'creep'.

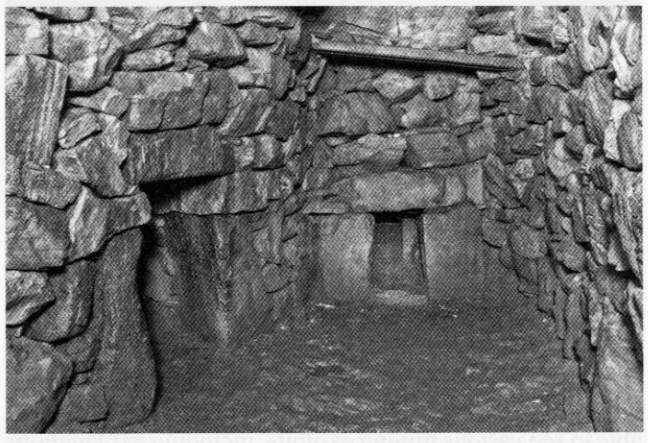


Linda Bartlett in the low entrance passage. Photo: Martin Dixon

What these things were made for is much debated. They may perhaps have been for use as storage places or hiding places in times of danger, but there seems to be no consensus of opinion. Other theories range from a celebration of birth (emerging into daylight) or death (a final journey underground). It seems likely we'll never know, so it's fun to let the imagination run.

The Halliggye Fogou, on the Trelowarren Estate, is one of the largest and best preserved of the dozen or so monuments of this kind in Cornwall. It is associated with an Iron Age enclosure and believed to date from the fourth or fifth century BC. Pottery found here suggests occupation, of the land if not of the fogou, during a period of 700 years, into the mid-Roman period. Interestingly, this ancient monument was used by the World War II Manaccan Auxiliary Unit for ammunition storage.

The entrance was restored in 1980, with modern steps leading down to the original 20 metre-long cut-and-cover straight main passageway. A second point of access, at the end, has now been blocked. An opening on the left in the first passage leads into a 28 metre-long curved tunnel, at the end of which is a deliberately left obstruction and small cell enterable only by way of a creep. Most of the souterrain has a floor-ceiling height of the order of two metres, so is easy to walk through.

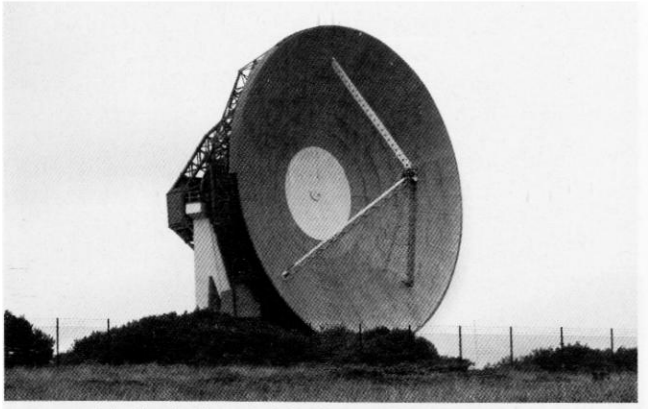


Entrance passageway of the Iron Age Fogou at Halliggye, dating back around 2,500 years. The facing arch leads to a short passageway and a former entrance. The arch to the left leads to a 28 metre passageway. Photo: Chris Howells

RAF Drytree (NGR SW 727214) **aka 'Goonhilly'**

Back in the minibuses and off to our fifth site of the day. There was nothing underground to visit here, but we enjoyed a pleasant walk around – using the map provided in our Notes Packs. The site is now managed by English Nature, so there is some pleasant vegetation along with many butterflies and wild flowers.

In World War II, twenty radar installations were erected across the UK to detect incoming aircraft – they became known as the 'Chain Home' network; in 1937 the network was extended and the Drytree site selected as Station 16, the most westerly in the UK, and was designated as a Chain Home Low station. The name possibly comes from an on-site Standing Stone (menhir), dating from prehistoric times, and RAF Drytree came into existence



'Arthur', the world's first parabolic satellite communications antenna. Photo: Chris Howells

– it was not actually named Goonhilly, to prevent confusion with the meteorological station nearby.

On the walk round, it was possible to see the bases of many of the radar installations. There is one building preserved, the Type B Receiver Block, which we were able to go into – and to get up onto the roof for splendid views all around, including the Goonhilly transmitter/receiver dishes.

Sub Brit member Benjamin Oldcorn had provided some of the site information as he's been studying the site as part of his Master's degree dissertation.

RAF Treleaver (NGR SW 766176)

Our final stop of the day was almost on the coast, at nearly the southernmost tip of Cornwall, down some of the narrowest roads yet. The big disappointment at this site was that we had planned to look round the Lizard Ales Brewery, occupying the first floor of the bunker here – but in Martin's phone call to confirm arrangements the day before, the chap suddenly found he had to go out for the day! A missed sales opportunity we thought... However, the local farmer kindly agreed to meet us in between milking his cows and allowed us access to the site and buildings present.

The R6 blockhouse at RAF Trelever. Photo: Nick Catford

RAF Treleaver was a Ground Control Intercept (GCI) semi-sunken blockhouse (R6), similar to Hack Green. Luckily, most of the surface buildings on the site survive and we were set free to explore each of them in turn. Most were used by the farmer for various farming activities – cow-sheds and storage mostly, so there was a fair bit of farm muck to negotiate!

The north wall of the main block has been breached in two places with earth ramps into the upper and lower level to give access for farm machinery. Internally the lower level is flooded to a depth of 9" throughout and is currently not used by the farmer. All the original teak floors were stripped out when the site was first sold and all the partition walls on the north side of the main NW/SE spine corridor have been removed leaving a long rectangular area with an earth ramp to surface at the western end. The corridor itself is above the water level.

The rooms to the south side of the corridor remain intact although largely stripped. At the eastern end the stairs up are still in place and the first room west is the former air conditioning plant and switchgear room with steps down from the corridor. This room is also flooded to a depth of 9" with a liquid that resembles a thick vegetable soup. The room has been largely stripped leaving concrete plinths where equipment was mounted. The main air conditioning fan is still in place together with some ventilation trunking and filters. A ladder leads up to a sub level where there are two more concrete plinths labelled 'Chilled water pump' and 'Baudelot pump'. There are further filters lying on the floor in this area and the base of a second fan. The next room west is the radar generator room, which contains three large concrete plinths and ventilation trunking. Alongside this is the GPO room, which has been completely stripped (probably by the GPO prior to sale)

The two level operations room, now stripped of all fixtures and fittings. Photo: Nick Catford

The guardhouse bungalow was not accessible – it has been converted into a dwelling, though the owner came out for a chat with the group. The rooms in the bunker are largely intact and accessible, though as I have said, fairly mucky with years of farmyard debris. Once finished in the main bunker, we were then able to visit the other remains across the fields – the modulator building and the radar plinths. There also appeared to be what looked like the dog kennels – subsequently used for pigs!

Then, back on the buses (a bit of snoring now) and back to Tremough.

Saturday Evening Conference Dinner

We'd arranged a group dinner for the evening. Logistics were a bit complicated as the AIA were having their conference dinner as well, so they were downstairs in the Refectory and we were upstairs. Luckily the bar was open beforehand so we were able to stock up on drinks and wine with the meal. Dinner was nicely served by the waitresses and seemed to go down well with everyone.

The big bonus came after dinner. The AIA conference organisers had arranged an evening's entertainment for their attendees – which we got for free and could hear very well up on our balcony! They welcomed the Cape Cornwall Singers – a wonderful group of twenty or so male singers, with beautiful voices, singing unaccompanied. Their locally-based songs include many references to Cornish miners and underground mining – so particularly fitting for Sub Brit. We stayed chatting and listening for a long while.

Rosevale Mine [SW 458378], Zennor – Sunday morning 5 September

The weather had remained kind throughout Saturday, but Sunday morning was to be different: unrelenting rain and low mist!

Despite that, Rosevale Mine was easily voted the best site of the weekend by the 45 attendees. We split into two groups, with those not wanting to ascend the vertical ladders in the first group, while those of us in the second group looked round Zennor Museum first.

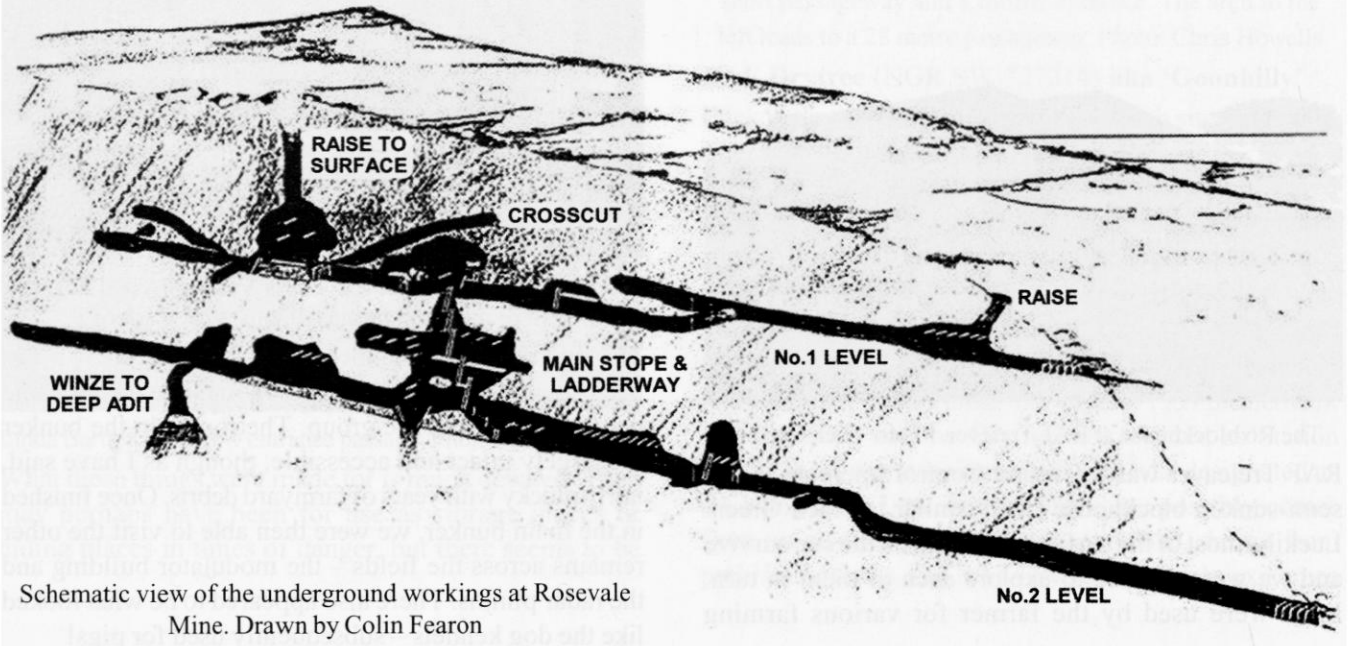
Rosevale Mine, in its early life, was small and unproductive. It is now a little larger, as it is gradually being extended by a small team of volunteers as a hobby-cum-labour-of-love. It is just as unproductive as ever – almost nothing but granite has come out to date!

Looking west along No. 2 level from a point close to the adit. Photo: Rob Selley

During the nineteenth and early twentieth century a little tin ore (cassiterite, tin oxide) was taken from two lodes, the principal one (Red Lode) being worked into the hillside for around a thousand feet via an adit or approximately horizontal mine tunnel. Between 1906 and 1912 a total of three tons of processed ore (and many more tons of granite) were extracted. Shortly afterwards a workforce of 36 was employed, but the mine was closed as unremunerative after a few years. Considerable capital expenditure was laid out on a surface processing works, the foundations of which remain in situ.

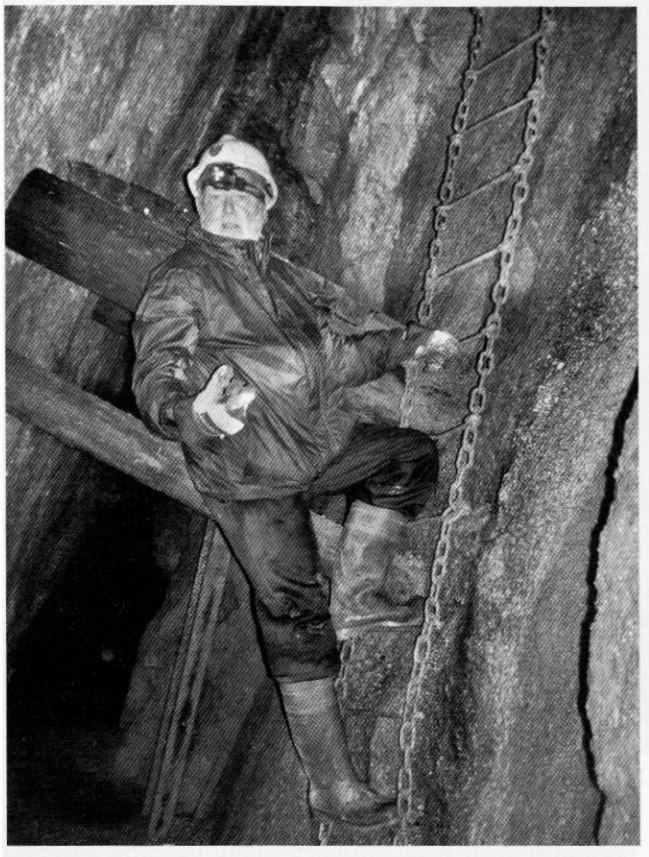
The mine remained abandoned until 1974, when a lease was taken by the West Cornwall Mining and Mineral Club. That group was disbanded the following year, but two of its members continued the lease and formed themselves into the Rosevale Historical Mining Society. The leading members are Mike Ship and Tony Bennett, to whom we are indebted for their hospitality.

Paul was in the first group – he describes his visit. The mine was reached by following a rough track inland up the Foage Valley from Zennor, and crossing a small stream.



Schematic view of the underground workings at Rosevale Mine. Drawn by Colin Fearon

Arriving at the site, we found some lock-up sheds, sundry bits of heavy mining machinery, and our guides for the visit. A choice was offered. We all entered at the lower adit; those feeling up to it could climb something like 100 feet of near vertical ladders up a stope, and exit via a higher-level adit further up the hillside. The less adventurous could content themselves by looking up the ladderways, then retracing their steps to the outside.

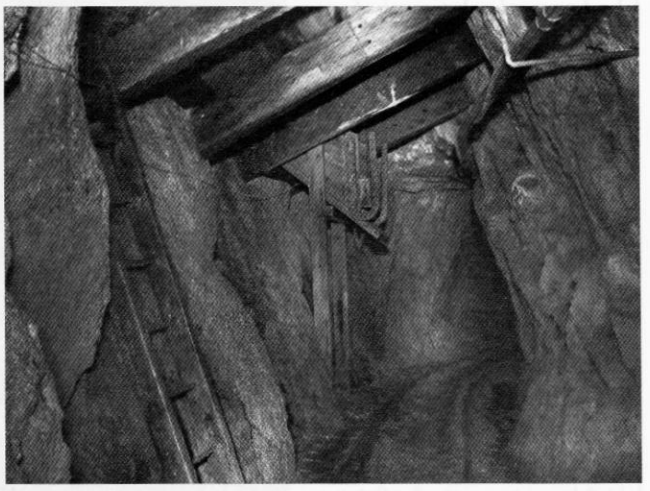


Chris Leaning sampling the chain ladder between levels. Photo: Martin Dixon

Inside the bottom level, we were shown what is left of a miserably thin vein of ore still visible in places in the ceiling. Ore-chutes and stemples were explained. We traversed a short new tunnel driven by the enthusiasts and peered down a shaft they had sunk to a lower level, currently partially blocked and flooded. The highlight, for those who chose the through-trip, was climbing the ladderways up the steeply inclined stope. We were thus able to view that part of the mine where most of the ore-getting actually took place.

Wayside Folk Museum, Zennor – Sunday morning 5 September

The second group had a chance to look round the museum first. This is a wonderful collection of relics from Zennor. The village is remote and was inaccessible by road until 1800 – so there was a long reliance on ancient implements and customs. The collection now has over 5,000 items displayed in a series of ancient buildings, showing life as it was in Zennor – including a few mining artefacts. We then adjourned to the next-door building, now set out as a café, to have a welcome and warming cup of coffee, before we set off for our visit to Rosevale (described above.) We enjoyed our Rosevale trip tremendously, emerging grubby, damp and happy into the pouring rain to make our way back down the hillside to the warmth and dryness of the coach.

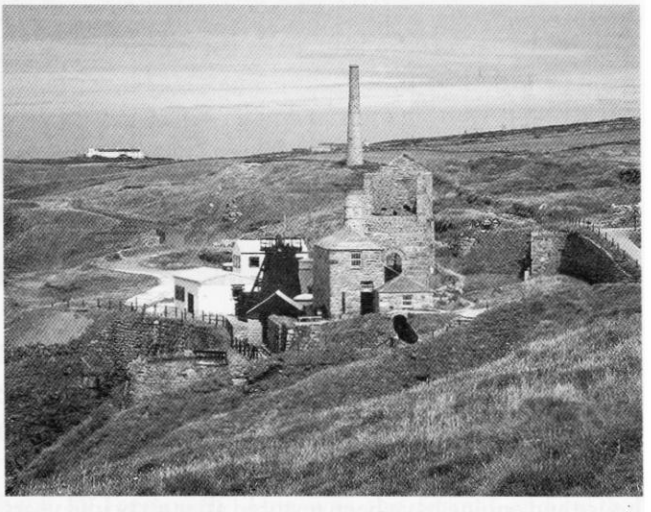


Ore-chute in No 2 level in Rosevale Mine. Photo: Rob Selley

From Zennor, we travelled by coach, tucking into our packed lunches, down the very narrow winding coast road. Many thanks to our driver who risked going against the flow of traffic (coaches normally travel the opposite way on this bit of road, to avoid congestion) – and skilfully managed to pass a German coach going the opposite way (we were bigger than them!). Arriving at Levant, we were disappointed to learn that the coach wouldn't be able to go down the narrow road to the mine, which left us with a walk of nearly a mile and curtailed the time we had for looking round.

Levant Mine and Engine House [SW 368346]

Levant is one of a number of mines which were worked out under the sea, from shafts perched right on the edges of the cliffs. Most of the mineralised rock is in the Killas in that direction (see panel on Geology), rather than inland in the granite. One can only speculate how much ore has been lost by marine erosion, although it must all have been redeposited somewhere.



The Levant Mine site from a distance. Photo: Ton Corser

The man-engine

Getting men in and out of seriously deep mines has been a problem which has had several solutions before modern times, when electrically-powered lifts in vertical shafts, or inclined drifts (usually zig-zag or spiral on plan) negotiable by people-carriers, are the preferred methods.

Men could be lowered and raised, as were supplies and ore, in kibbles (large buckets) in the shafts. Or men could climb down, and back up, near-vertical ladderways in shafts or stopes (worked-out veins): a time-consuming, exhausting and dangerous procedure for cold, wet and tired men after a day's work.

The man-engine, used both in Cornish and German mines, enabled large numbers of men to descend and ascend with far less effort, and much more quickly. This was an immensely stout vertical or near-vertical timber beam, almost as long as the depth of the shaft. Fixed to it at regular intervals were little platforms, each just big enough for a man to stand on. Fixed to the wall of the shaft were similar platforms, at the same intervals. The whole contrivance was suspended from the end of the beam of the steam engine working the shaft. As the beam went up and down, the man engine went up and down a short distance in the shaft.

The man-engine at Dolcoath in 1892

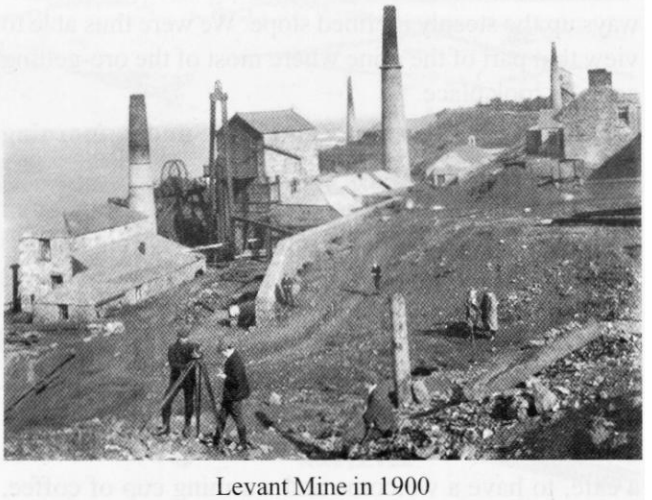
A man descending stepped onto the first platform on the engine, descended, and stepped sideways onto a platform on the shaft wall some feet lower down, when the platform he had been on went back up again, as did the next platform below it, onto which he now stepped, to descend again as before. And so forth until he reached the level at which he was able to walk to work. The reciprocating man-engine beam, of course, never stopped. Each man had to step from beam to shaft wall and back many times to ascend and descend. Timing was all. You couldn't miss a turn, as all the platforms were built only to take a single man.

The Levant man-engine

The short underground visit at this site is a shallow tunnel leading to a point near the top of the former man-engine shaft, down which awesome deep we could peer. Those who had been studied the exhibits in the King Edward Mine Museum, or who had done their homework, were familiar with the concept of a man-engine (*see panel*). All worked well enough at Levant until the day the coupling at the top of the man-engine, attaching it to the engine beam, broke. The entire man-engine, carrying men and platforms with it, plunged down the shaft. On 20 October 1919, thirty-one men fell to their deaths in this shaft. A sobering visit.

The engine at Levant

Besides a small indoor display, including a view down the shaft here, the other main attraction at Levant is the engine-house. The original engine is still in working order, and today we were lucky enough to see it in steam. The house and engine have been restored after sixty idle years by a group of volunteers known as the 'Greasy Gang'. This remains the oldest Cornish steam beam engine remaining worldwide still in working order on its original mine site.



Levant Mine in 1900

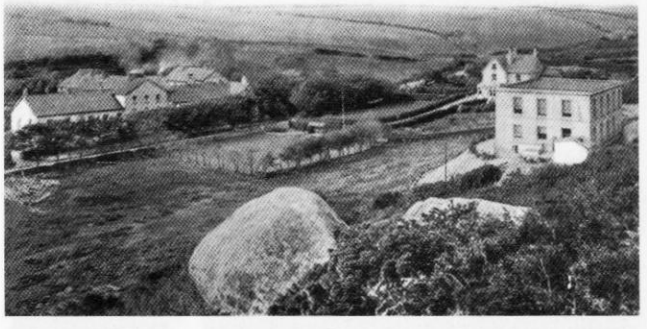
We clambered from floor to floor in this small building to admire the working parts in motion. With boilers functioning, and steam hissing here and there, this would have been a cosy point from which to admire the cliffs in the worst weather during the life of the mine.

Both Levant Mine and Geevor, a short distance north along the cliff-line, are open to the public by courtesy of the National Trust. Botallack mine, no less famous, is a short way further along the cliffs towards Lands End – no chance of seeing it today though, due to the inclement weather.

Back on the bus, we set off for the final visit of the day. En route we had hoped to have a view of a house in St. Levan converted from a World War II bunker guardhouse but sadly the cloud was down too low.

Porthcurnow Telegraph Museum [SW 384227]

Porthcurnow is on the south Cornish coast, a little southeast of Lands End. The old Telegraphy Station was set up by Cable and Wireless and was operational from 1870 to 1994. Latterly it was used a training facility and some of these buildings are now in use as a museum, with plenty of interactive exhibits for children, and a well-stocked bookshop.



Porthcurnow cable station and offices in 1909

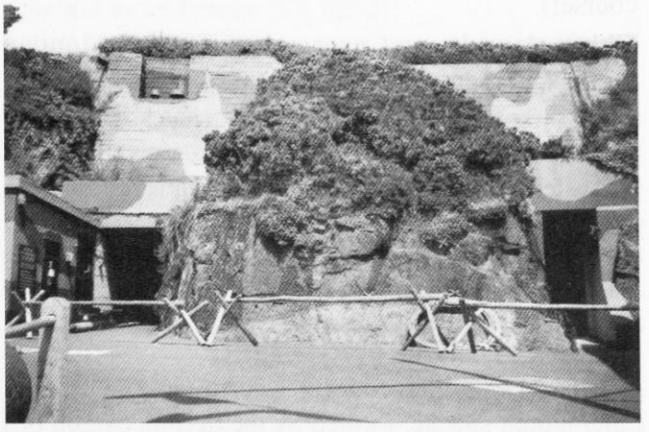
Our Sub Brit group was given free rein to explore here – so (as is usual in such circumstances) we scattered to the four winds! Some rushed off visit the Cable Hut on the beach, some climbed up to the Minack Theatre, way up on the cliffs, and Martin and I sneaked off for a Cornish cream tea (after a quick visit to the Hut and the museum, having visited before).

The Cable Hut

This is a tiny building, overlooking the beach and surrounded by sand dunes. Here is the termination of 14 undersea telegraph cables, including those crossing the Atlantic. Sadly the hut wasn't open (due to the atrocious weather) which was a real shame. If open, we could have seen the original termination gear. The cables are marked with 'luggage labels' inscribed with the origin of the cable, for example, "Gibraltar".

The Submarine Telegraphy Museum

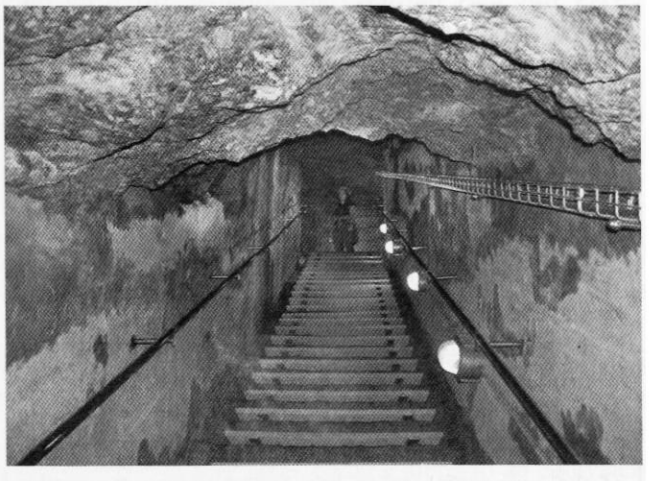
However, the main star of the visit was the underground experience. There are two 150-foot long parallel tunnels, with linking cross-passages. The tunnels were carved out by Cornish miners at the start of World War II, and were constructed to be bomb and gas-proof. Britain's undersea cables were of vital importance and the tunnels provided protected accommodation for the telegraph equipment.



The two parallel tunnels at Porthcurnow

Today, the tunnels are crammed full of telegraphy exhibits. Our visit started with a well-presented (though a bit lengthy) introduction, by a real live man, not some electronic gadgetry. This, and the now antique electrical equipment (lots of brass and ebony!), brought back memories of A-level physics lessons!

At the end of the tunnels, there is a door leading to a stairway constructed within the cliff to provide an emergency exit. We ascended the stairs and exited at the top, from which there are good views (on a clear day!). Most of us took the chance to climb up here (getting quite puffed on the way). The steps have been nicely preserved; in these days of Health and Safety it is good to see that they have left the original World War II steps in place and overlaid these with a new set of steel grid steps – so you can see the originals but still be safe.



The WW2 stairs at Porthcurnow. Photo: Martin Dixon

For further information visit www.porthcurnow.org.uk .

Sunday evening – the end of the Visits weekend (nearly)

Tired and happy, we piled back into the coach for the trip back to Tremough. This was the formal end to the weekend, but nearly forty members had elected to stay

on for another night. We'd suggested that people make their own arrangements for dinner at local pubs and restaurants; in the event about 25 of us ended up in the same pub, where the chef did exceptionally well to rustle up some excellent meals for us all (and a few pints of course!).

China clay pits and processing works – Monday morning 6 September

Bidding farewell to Falmouth, the remainder of the group (now in cars again) headed back northeastwards to the St Austell area in thick mist and steady rain. Assembling at the Wheal Martyn China Clay Museum [SX 005554] we met our guide, Ivor Bowditch, for the last set of visits for the weekend which, fortunately in view of the very wet weather, took the form of a coach tour of china clay pits, processing works, and (via the Pinnock tunnel) the harbour at Fowey.

China clay and its processing

China clay is the mineral Kaolinite, a hydrated aluminium silicate, formed by the decomposition of feldspars in Granite. The feldspars, a family of related minerals, are alumino-silicates of calcium, potassium and sodium.

The decayed granite is extracted from very large, deep, open pits, where the kaolin occurs still mixed with the other minerals in the original granite – primarily quartz, one or more minerals of the mica family and sometimes smaller quantities of horneblende or tourmaline.

Extraction

The 'mining' is effected by directing powerful jets of water at the decayed granite, and pumping the resultant mineral slurry to processing works at ground level.

Mineral waste

The china clay is separated from the other minerals by a series of water-based processes, whereby the very fine clay particles are 'floated' off from the heavier and bulkier residues, for which almost no uses have been found. The famous 'Cornish Alps' are the huge glaringly white conical spoil tips of quartz sand and other rejected materials, resembling snow-capped mountain peaks which are a characteristic of this industrial landscape. More waste mineral has been impounded behind bunds and allowed to revegetate, creating potential new nature reserves.

Unfortunately, no market has been found for the vast bulk of the mineral refuse. However, there is now a significant sale (for aggregate) for some of the larger and harder lumps of rock washed out of the deposits by the water jets (called monitors). Reputedly, some of the muscovite mica has found some use as the 'glitter' on Christmas cards – but the demand for this application is hardly in the millions-of-tonnes category! A study by the British Geological Survey in 1987 considered the potential of the mica in the china clay waste as a source of lithium, but evidently without an economic result.

The clay pit at Wheal Martin seen on a good day.
Photo: David Stowell

Through some mis-communication, the hard-hats and high-vis jackets promised by IMERYS (through which the tour had been arranged) had not been provided, but as we are Sub Brit, a quick raid of our cars provided us all with the necessary hard-hats and jackets – well done us! Off we went.

Tour of China Clay works

The first stop was a viewing platform from which, in clear weather, we could have admired the biggest opencast mineral works in the British Isles. All we could see was impenetrable fog. Photographs were taken of the 'viewing platform' sign, and the fog in the background. Paul Sowan, who has enjoyed a conducted tour around the bottom of this pit on a good day, did his best to explain what we might have seen in better weather!

There then followed a coach tour around several more equally fog-filled pits, with Ivor explaining all the features we couldn't see. Whole villages have been moved aside to allow continued extraction of Cornwall's most economically important export. The company even sells china clay to China! And the industry has established new villages of company houses for its employees, one or two of which we were able to admire through rain-streaked windows. A route map would have aided our appreciation of this fog-bound industrial landscape!

China Clay Processing

There was more to see indoors! We were conducted around several extremely large and complex processing works, where the clay is separated from unwanted impurities, sorted into a surprisingly extensive range of size and quality grades, and dried and prepared for sale.

In one of the processes, a pair of gigantic electromagnets (probably bigger than any of us had ever seen) was used to remove any magnetic iron oxide particles (a minor component of the original granite) from the clay feedstock.

The purified clay slurry has much of the water squeezed out of it in large filter presses: this process seemed to be amongst the more labour-intensive aspects of the works. And drying the clay is similarly energy-intensive.

For all of us, this was a fascinating insight into some real British industry in action. We are most grateful and appreciative of this chance to see what is such a rare sight in Britain these days – people actually manufacturing something! Leaving the factories, we now headed for Fowey docks – via the former Pinnock railway tunnel.

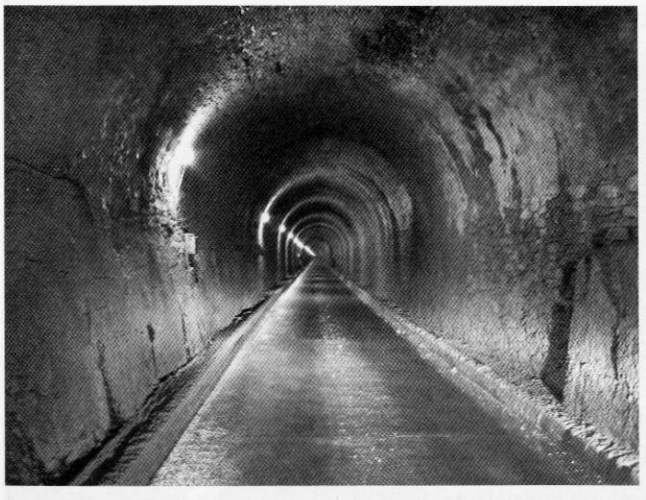
Transport and Railways to Fowey

Cornwall's roads are hardly well adapted to fast heavy freight traffic. Much china clay is exported via the port at Fowey; some goes by road, via Par and the former Pinnock rail tunnel; a great deal more still goes by rail, via Lostwithiel.

The development of rail access to Fowey was less than straightforward. It was served by two lines, arriving from two different directions, one of which is now completely closed, and the other is now freight-only.

Fowey has an historically important deep-water harbour on the east bank of the Fowey River, a little over five kilometres southeast of Par (another significant port) on the Cornwall main line.

The first line to Fowey opened as a long branch from Lostwithiel, along the west bank of the Fowey river, in 1869. This remains in use, for freight traffic only. In 1874 a second line to Fowey, with the Pinnock tunnel, opened from near Par.



Pinnock Tunnel. Photo: Nick Gilchrist

Pinnock tunnel [SX 100536 – SX 110533]

Pinnock tunnel, with a length of 1,173 yards, was by far the longest rail tunnel in Cornwall. It was a single-bore single-track rail tunnel of exceptional interest on account of its being far from dead straight from end to end. The line (and tunnel) closed to rail traffic on 4 January 1965 and is now leased from Network Rail by IMERYS and is in use as a private road for the company's exclusive use to transport china clay to the docks at Fowey.

We were allowed to travel through to the docks and back on our coach. Walking through was not an option, on account of heavy works traffic. The tunnel is lighted throughout, with traffic allowed through in alternate directions controlled by traffic lights at each end.

The docks at Fowey [SX 1252]

Having traversed Pinnock Tunnel, most of us were surprised to find a serious deep-water dock with standard-gauge track and locomotives, and big rail-mounted cranes all very much in active use. A bonus for the really hardened railway enthusiasts was a traverser at what is now the end of the line at Carne Point: a device for moving a locomotive and each emptied waggon in turn sideways onto the return line back to Lostwithiel, where otherwise a loop line would have been needed where there isn't space for one. The main cargo handled here is, obviously, china clay. But we did have pointed out to us a consignment of rock salt (for use on icy winter roads) which had been shipped in from Northern Ireland.

Our china clay tour concluded, we returned in the hired coach to Wheal Martyn where some had lunch in the cafeteria, some set off in the rain for home, and some accepted Sue Monsell's invitation to visit her ROC post.

And so ended another splendid weekend.

The End

Your rail-travelling correspondent (Paul), kindly dropped off by Brian Hillman in St Austell, found his way to a town-centre pub where, through sheer chance, he fell into conversation with the former Chief Chemist at the china clay works. We entertained each other with tales of our teenage chemical pranks! Then a train back down to Penzance where the weather could hardly have been better, a pleasant evening and pub-crawl around the harbour, dinner, and the day ended tucked up in bed on the sleeper back to Paddington.

Thanks again to Linda and Martin, whose hard work and painstaking attention to detail always guarantee the success of both the British and European Study Weekends. As usual, they produced a very helpful and informative information pack for everybody.

And special thanks also to Kevin Baker of the Carn Brea Mining Society, who had made many of the local arrangements on our behalf and stayed with us throughout the weekend.

Linda and Martin finish by thanking the 45 Sub Brit attendees who came and made the weekend such fun and even managed to stick to the timetable (most of the time!) and no one got lost! If you fancy coming along to an equivalent weekend, then look out for Sweden and Manchester in 2011 – dates in the 'Diary' section of this magazine.

Further reading

BROOKS, Tony, and John WATTON, 2002, *King Edward Mine: an illustrated account of underground and surface operations 1897 - 2001*. St Austell: Cornish Hillside Publications: xii + 132pp [ISBN 1-900147-27-0 (cloth) / 1-900147-26-2 (paper)]

Subterranea Britannica

Notice of Annual General Meeting 2011

*** *Important Information* ***

The AGM will be held on Saturday 9 April 2011, commencing at 1000

at a central London location, in association with the Spring Meeting.

***

Documents for the AGM will be available on our web site at www.subbrit.org.uk
at least 28 days in advance of the meeting. These will include:

* Agenda for the AGM.
* Chairman's Annual Report.
* Accounts for 2010.
* A form to nominate members for the Committee.

Members will be e-mailed to advise when such documents are available.

Those members who have registered to receive documents by post will be sent them when they become available. You can elect to receive paper documents by filling in a form available from Sue Monsell at our registered office address.

***

Minutes of the Annual General Meeting 2010 were printed in *Subterranea 23,* June 2010.

Spring Meeting 2010

Saturday 9 April 2011, commencing at 1030

at a central London location, to be confirmed.

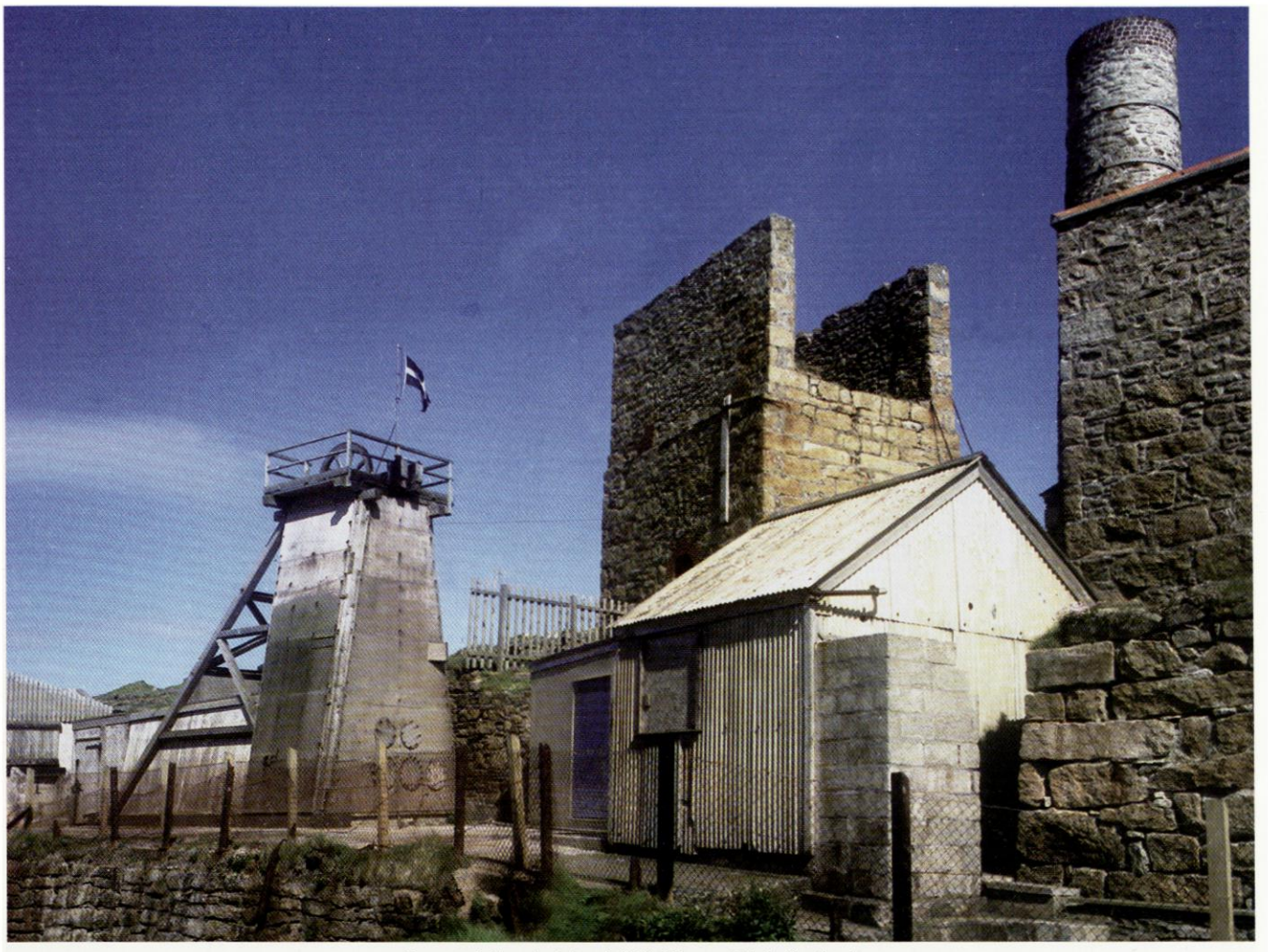
***

There will be the usual mix of interesting illustrated talks by a number of Speakers;
along with Members' contributions and a chance to
meet and mingle with fellow enthusiasts.

***

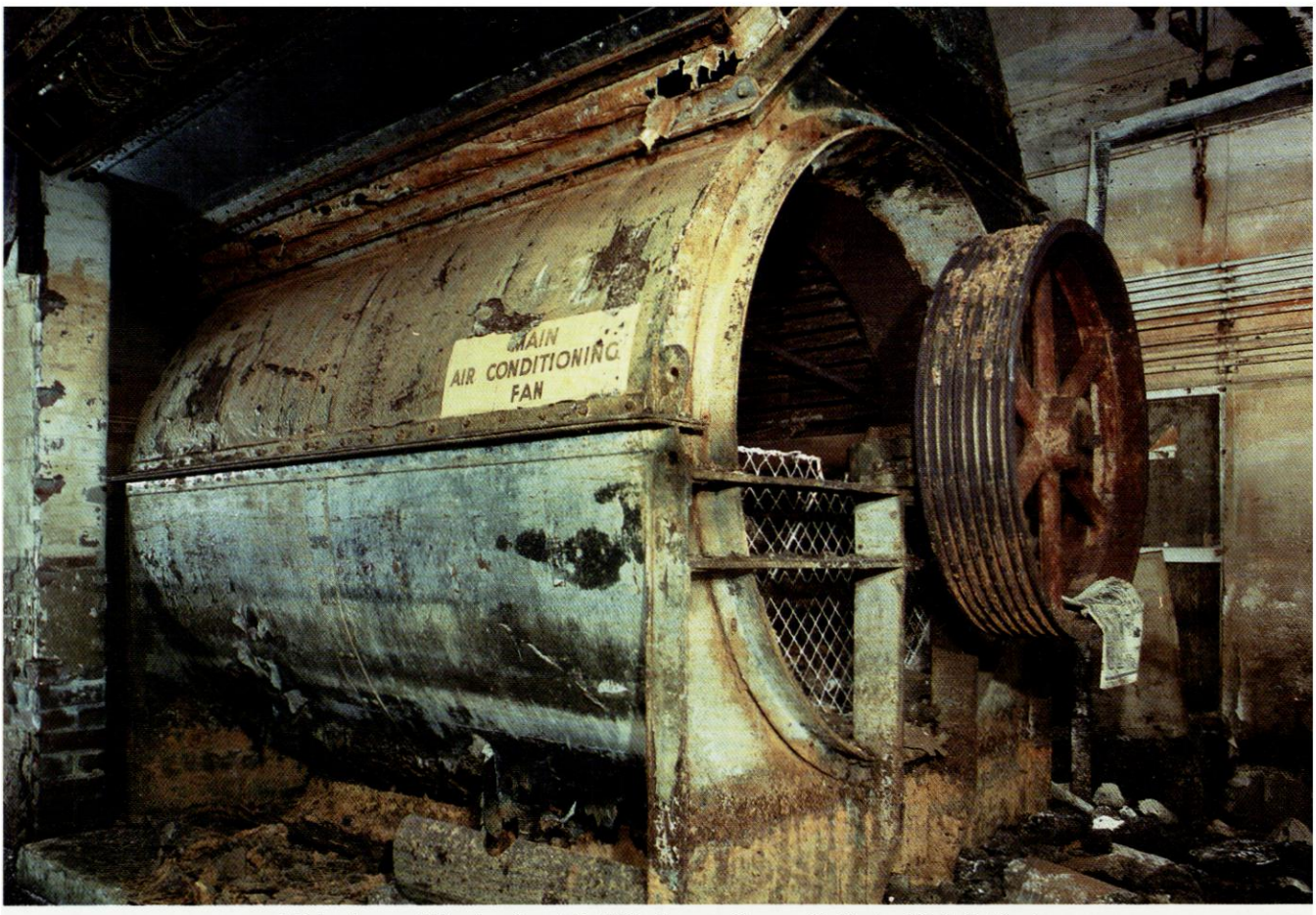
The Agenda for the Meeting will be published electronically on the website,
along with the Booking Form (unless you have registered to receive documents by post,
in which case, they will be sent to you with the AGM papers).
You will be sent an email to advise you of the location on the website.

Please put the date in your new 2011 diary now!



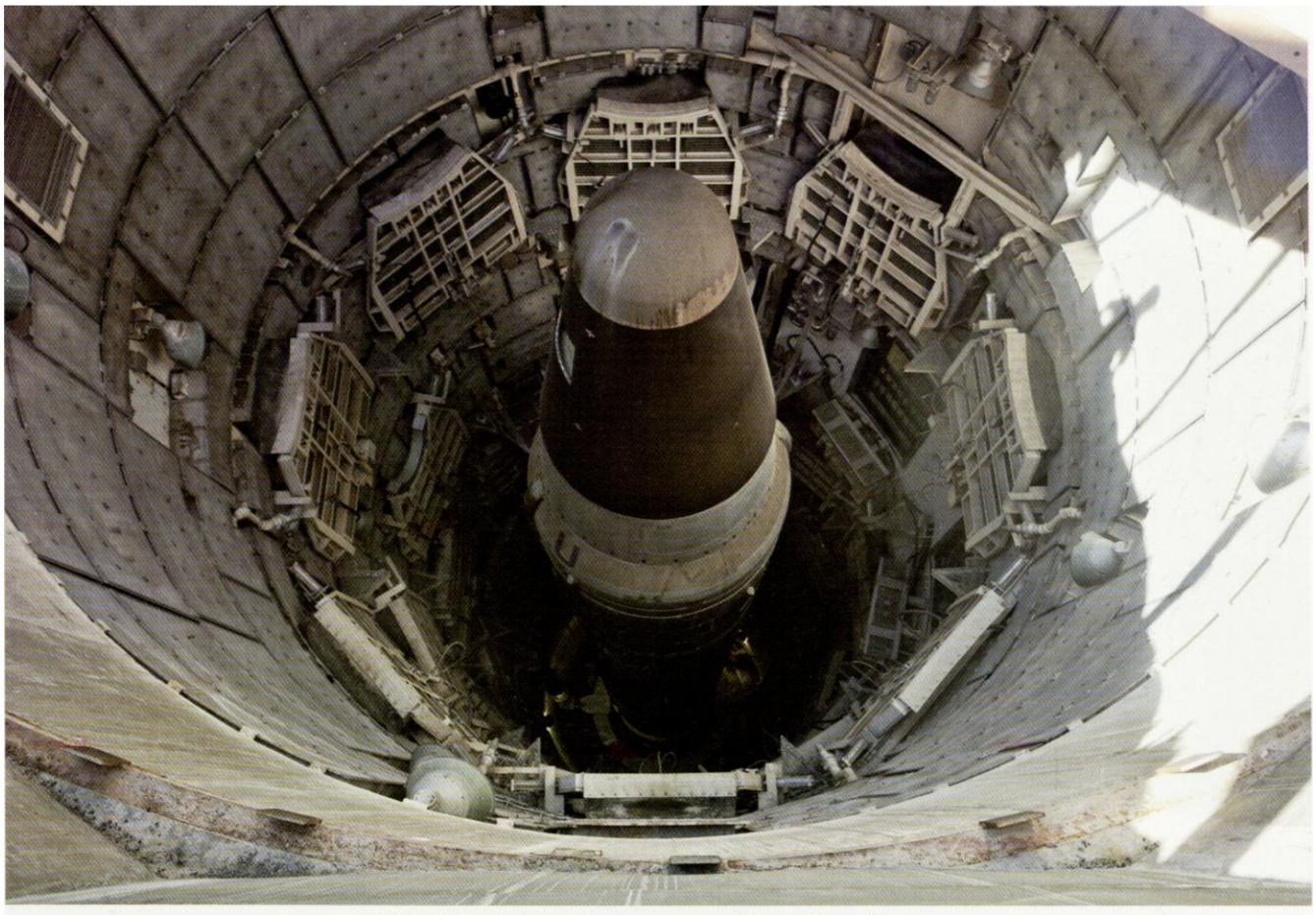
Levant Mine in May 1995. Photo: Nick Catford

Colourful stope at Rosevale Mine at Zennor, Cornwall. Photo: Rob Selley

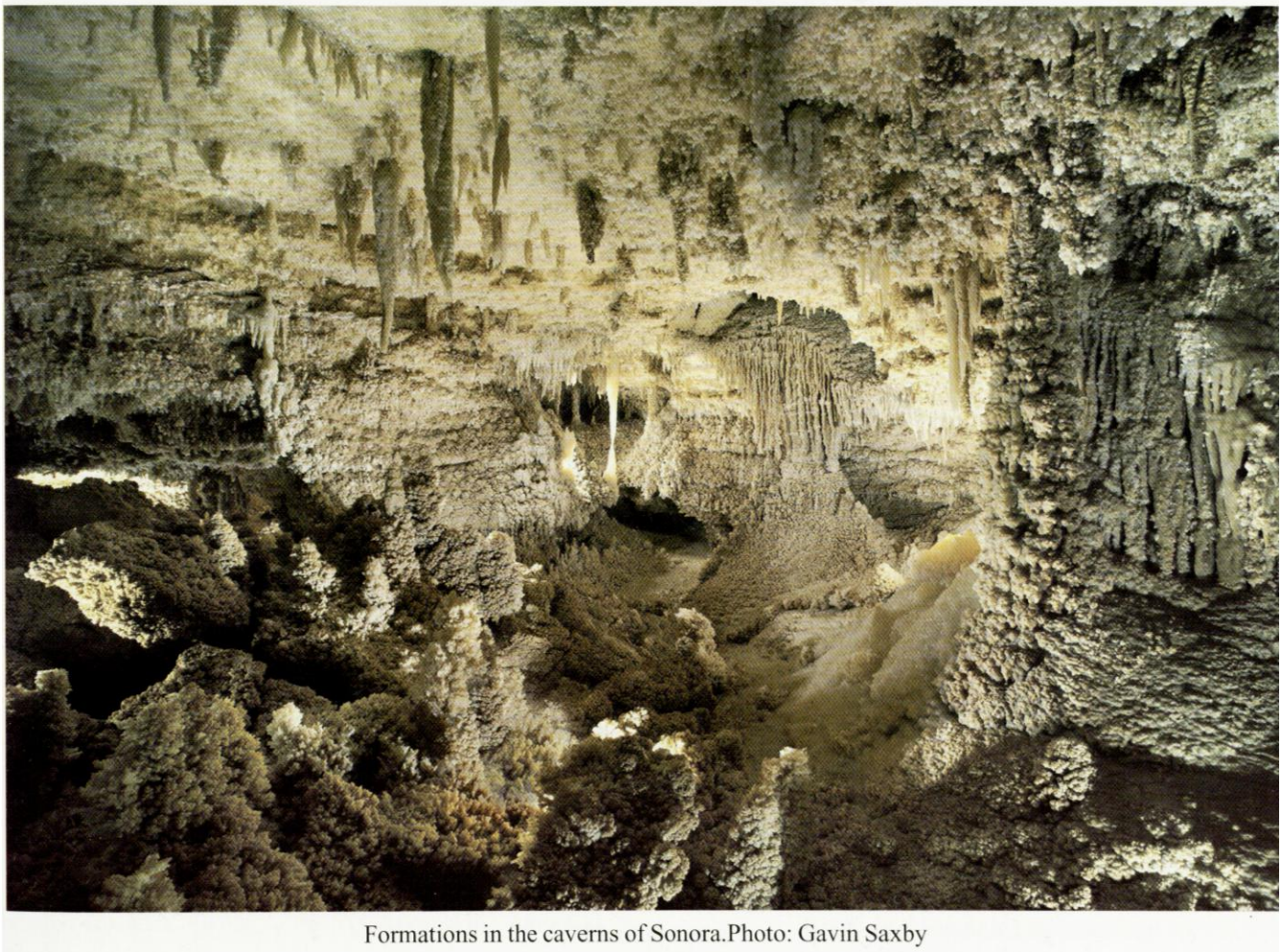


Main air-conditioning fan at RAF Treleaver, Cornwall. Photo: Nick Catford

Consoles in the upper-level control room in the command centre at RAF Laabruch. Photo: Nick Catford



Titan Missile in its silo in Arizona. Photo: Gavin Saxby



Formations in the caverns of Sonora.Photo: Gavin Saxby

Looking north along the south tunnel beneath Ewell House in 1997. The branch to the right collapsed in 2001 and was subsequently backfilled. Note the vaulted buttressing found at many of the tunnel intersections. Photo: Nick Catford

Old drill bits being re-used as reinforcement in the World War II air-raid shelter for workers at East Pool and Agar Mine. Photo: Martin Dixon

A Day-Trip to Weeze
(or you can't beat landing where you're exploring)

by Tim Robinson

Some trips require a series of transport changes; arrive at the airport, collect the hire car or get on a train, travel for an hour or so, start exploring.

Weeze on the other hand requires nothing more than exiting Customs and wandering to the pre-booked minibus parked outside. Before you join me and my fellow travellers on our tour of the airbase in June this year, here's a little history of what we were going to see.

In the beginning

RAF Laarbruch – Weeze is its current civilian name – is located in Germany close to the Netherlands border, southeast of Nijmegen, and started life in 1953. NATO considered a Soviet strike in Central Europe a real possibility and knew it lacked serious air power west of the Rhine so started an airbase construction programme, Laarbruch being one of them.

By the end of 1954 the base was operational with the arrival of three RAF squadrons of Meteors and Canberras effectively confirming the start of the Cold War. 1970 saw the arrival of a dedicated airfield defence system in the shape of Mk 2 Bloodhound SAMs following the crisis in Czechoslovakia in 1968…

Dateline 19-20 August 1968 – Following the Prague Spring, Warsaw Pact countries invaded Czechoslovakia to stop First Secretary Alexander Dubcek's political reforms. The attack was extremely well coordinated and showed the West that a completely undefended airfield could be taken with minimal casualties and thus allow a massive airlift to be under way in a matter of hours. With men and equipment pouring in behind defensive lines the battle was over before it had started.

Throughout 1971 and 1972 the Canberras were replaced with Phantoms and Buccaneers which then served for the following five years on front-line duty. The Jaguar started to appear during 1977 as the Phantom was phased out but the Buccaneer remained in service until 1984. Finally, four Tornado squadrons arrived to replace the ageing Buccaneers and remained in service until 1992. Harriers, Chinooks and Pumas starting arriving in 1992 with Gazelles joining the fleet in 1995. A year later the helicopters started to disperse leaving just the Harriers which were the last fighting force to remain until the closure of the base in 1999. Around 2,200 servicemen and women and their families were stationed there although with visiting squadrons and local workers this figure often reached more than 5,000.

Aircraft based at Laarbruch took part in many NATO operations, most notably Desert Storm in 1990 (Tornados), the Bosnia crisis in 1995 (Harriers) and the Serbia / Croatia civil war in 1995 (Harriers and Chinooks).

The end of the Cold War

As the last aircraft left the base it was handed back to the German authorities, as was the case with many NATO airbases after the collapse of the Warsaw Pact. With so much real-estate back in the government's hands and no real idea of what to do with it, Laarbruch lay derelict for almost two years (what you could have seen in those years is anyone's guess!).

With a more structured plan in place and regional airports becoming popular, Laarbruch underwent a make-over and opened its doors to passengers in May 2003 under the name "*Airport Niederrhein*".

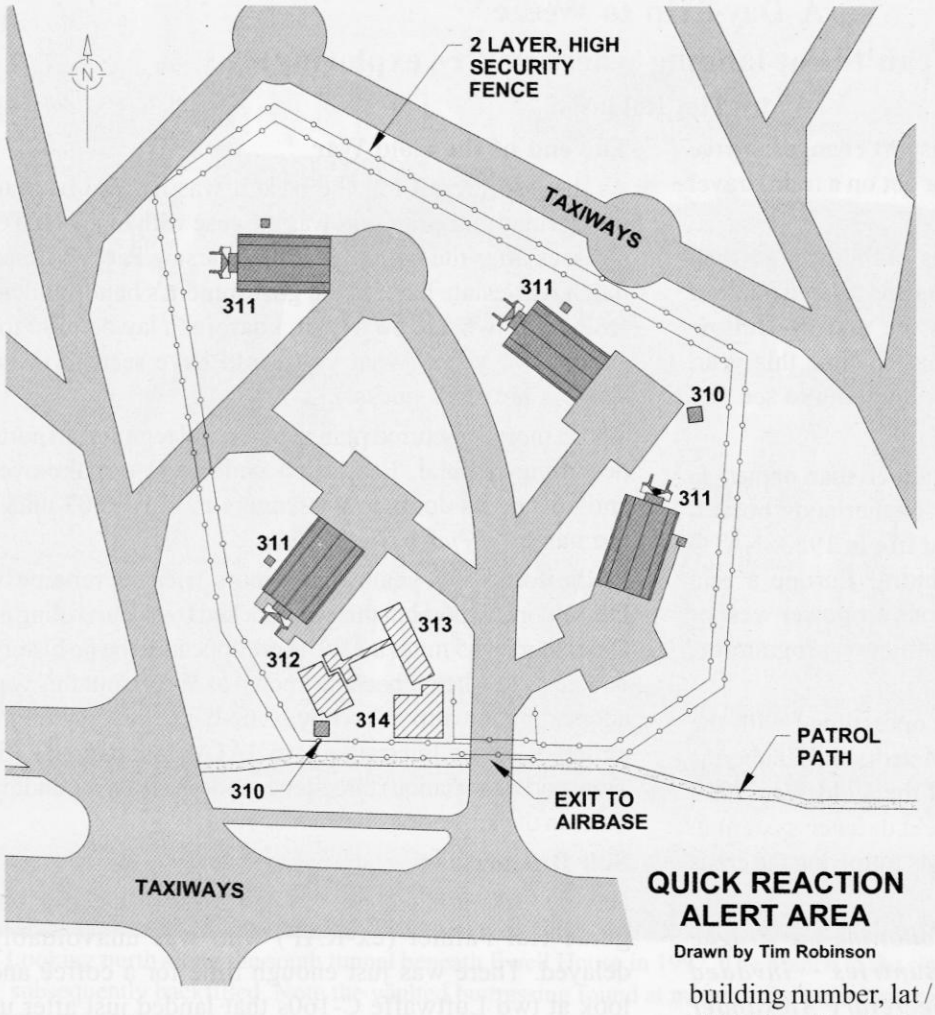
In the following years the owners tried to rename it Dusseldorf Airport but this was blocked by a court ruling as Dusseldorf is 45 miles away! There appears to be no history or date as to when it became known as Weeze but this was adopted by the airport and by some bunkerites' favourite airline, Ryanair. Interestingly its IATA (International Air Transport Association) three-letter code is NRN, reminding those in the know of its original name.

Sub Brit arrives

Having cleared Customs we had a short wait for our guide Hal Palmer (ex-RAF) who was unavoidably delayed. There was just enough time for a coffee and look at two Luftwaffe C-160s that landed just after us before we boarded the minibus for the start of our day. The group consisted of myself, Steve Underwood, Jane MacGregor, Robin Ware, Adrian Trice, Bob Clary, Michael Plock, Nick Catford, Chris Rayner, Dom Jackson, Alex Gould, Hugh Ainsley and Philip Lindhurst.

As we drove round the outer ring-road Hal introduced himself and gave a short history about the place and what we'd be seeing. Our first port of call was the QRA (Quick Reaction Alert) area. *The plan overleaf shows the layout and building numbers mentioned here.* There were 2 watch towers (310), 4 HAS (Hardened Aircraft Shelters)

Starfighter beginning its journey



QUICK REACTION ALERT AREA

Drawn by Tim Robinson

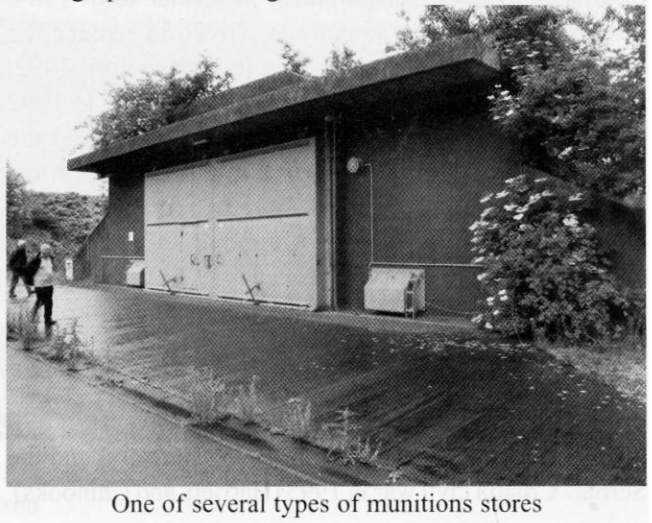
(311), pilots' quarters (312), offices (313) and a hardened guard house (314) Luckily we were just in time to see a long-time resident in the shape of an F-104 Starfighter being loaded onto a low-loader for its journey to a museum.

We departed the bus in misty rain but that didn't dampen our spirits as we moved from building to building, HAS to HAS, taking photos and exploring. One of the buildings contained pilots' quarters where they remained on call for instant reaction and several of the HAS were open so we could see internal equipment and floor markings.

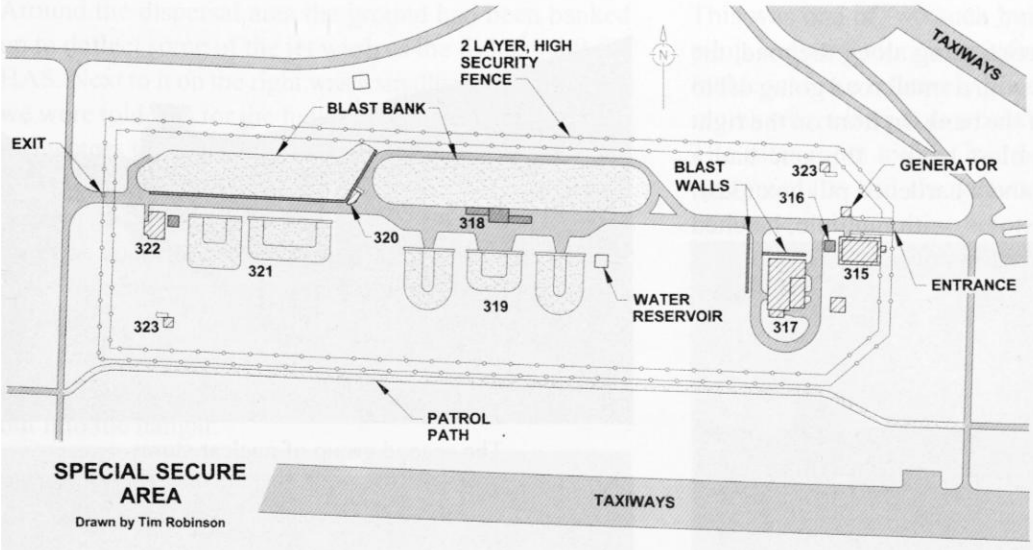
With the Starfighter gone, Hal gave us a demonstration of how the doors closed and opened. It was very impressive being inside when they finally thumped shut with a superb echo! Interestingly, each shelter has a panel up high giving its building number, lat / long location, height in feet and an HDG (heading in degrees) reading. The watchtower was not open and despite having a huge bunch of keys Hal didn't have the right one. Back on the bus we headed for our next destination, the SSA (Special Secure Area) where nuclear weapons were once stored and maintained.

En route, we stopped at two of the many conventional weapons stores dotted about. Much playing with the chains and locks for the doors resulted in our getting them both open, although as we were told, the insides were not much to look at. The walls were smooth cast concrete, painted white and both were completely empty – but you can't go past something and not have a look inside!

QRA Watchtower



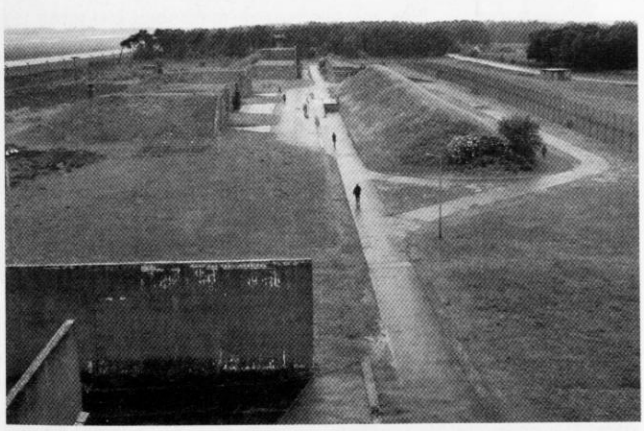
One of several types of munitions stores



We arrived at the SSA via the main road past the guardhouse. *The plan above shows the layout and building numbers mentioned here.* This was a longitudinal area surrounded by a double security fence and contained a watch tower at either end with weapon stores and other buildings in between. Splitting up and braving the increasingly harder rain I started in the hardened guard house (315). Very little left apart from the odd button panel and a tape deck unit on the wall, presumably for announcements in this area. Like most of these types of sites they are fairly well stripped but being on an active airfield most of the buildings have escaped the mindless destruction that often meets our eyes.

View from the top

Next was the first watch tower (316) which was open and echoed to the sounds of Sub Brit members running up and down the spiral staircase. The view from the top was very good and gave a nice panorama of this area. Inside had been visited by the pigeons but a bank of TV screens above head height confirmed the level of security. A nice item still intact was the mirror out on the walkway that was angled to show if anyone was waiting to get into the door at the base of the tower.



Overlooking the SSA

Across from the watch tower was the weapons maintenance building (317). The service bay ceiling was dotted with fluorescent tubes all in safety housings and a full-length 1000kg hoist. A couple of rooms off the service bay were probably offices and a much larger one that was tiled could have been an additional workshop or battery room. At either end there were folding sliding doors and outside, huge blast walls around two sides.

Walking down the main road I passed a loading ramp on the right (318) with a huge blast bank behind it. To the left were the first of the munitions stores (319). Three separate ones to the same design as those found on other nuclear-equipped airbases such as Hahn.

Nuclear weapons stores in the SSA

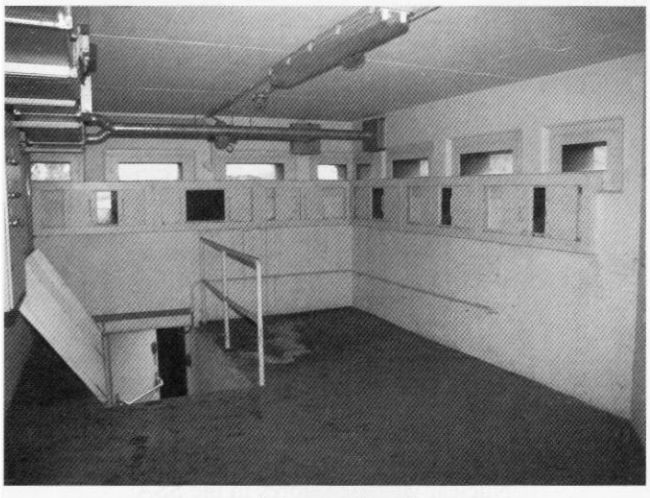
Inside the double store, the end walls and 2ft-high side walls were painted white but the arched ceiling was left with a textured concrete finish. Two microwave motion detectors on the end wall covered the overall store, one on a side wall covered the entrance door and across the two low-level ventilation grilles either side of the door there were trembler sensors. No one was going to just wander into here!

The last one of this group was a single store with smooth, white-painted concrete internal walls and curved ceiling. It had the same motion detectors and tremblers as the previous store but also a separate section at the back with a single leaf door opening. There were low level, empty openings as though someone had removed some grilles, cable clips around the walls and metal angle brackets in the ceiling. Nothing else existed to indicate what this was used for.

Numerous buildings

Back out in the rain and continuing along the road, the blast bank came to an end with a small road going off to the right round the back of the bank. In front on the right was the start of another blast bank – this one had a concrete wall around it – and a hardened pill box (320) facing the two groups of stores, with multiple, hatched gun slots and armoured windows over.

Hardened pill box and blast bank

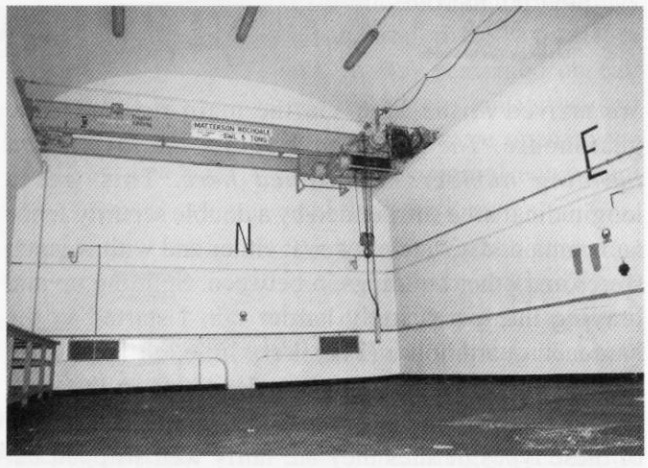


Internal view of the pill box

Access was down a flight of stairs, through a door on the left and back up some stairs into the pill box. Inside was again painted white and had sliding steel plates over the gun slots. On the back wall there were two large control panels with an A/C duct running above them. A hinged metal grille could be closed over the entrance staircase to hinder access from unfriendly forces.

The second group of stores was on the left (321). This consisted of two buildings, one quite low containing four separate stores again with curved, rough concrete ceilings and a single one at the end, much taller and more like another maintenance building. Inside was all white with a huge yellow, 5000kg gantry hoist spanning the full width. There were microwave detectors, a tannoy speaker and along the left-hand side, a workbench. Compass points were painted on the walls though so far I've not found out what these represent.

The second group of nuclear stores

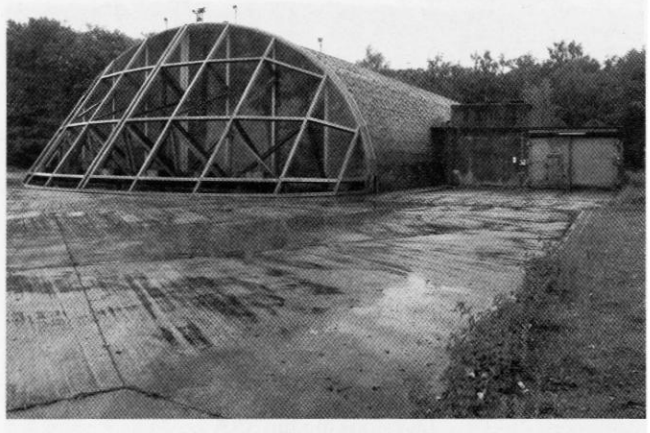


Internal view of the larger maintenance store

The last buildings at this end of the area were the second watch tower with ground level office (322) and in the distance near the outer fence, one of two half-sunken defensive positions (323). The other was diagonally opposite near the main entrance. I was almost last as usual so decided to head back to the bus which had moved further into the site, making the walk much shorter. It was also time to dry off my camera!

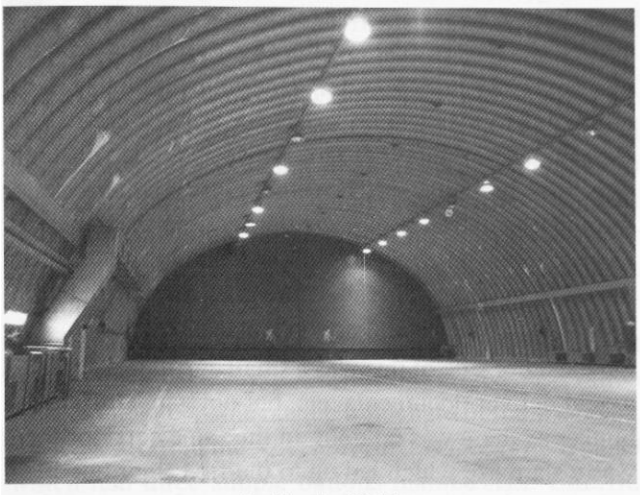
Hardened aircraft shelters

Next on the agenda was a more modern HAS, a type many will recognise as it has the girder structure supporting the sliding doors and can be seen on active USAF bases such as Lakenheath.



HAS and bowser building

Around the dispersal area the ground had been banked up to deflect some of the jet wash as the fighters left the HAS. Next to it on the right was a smaller building which we were told was for the fuel bowsers. Inside there were connectors to the fuel tanks and a pitched, grilled, open roof over about a third of the floor area. *[Reading some historical notes back home it was interesting to see that the doors of these fuelling buildings were built a little too low so when empty tankers tried to leave they fouled the door head! More often than not they went into the hangar area to refuel the fighters.]* From the fuelling area you went through two blast doors and out into the hangar.



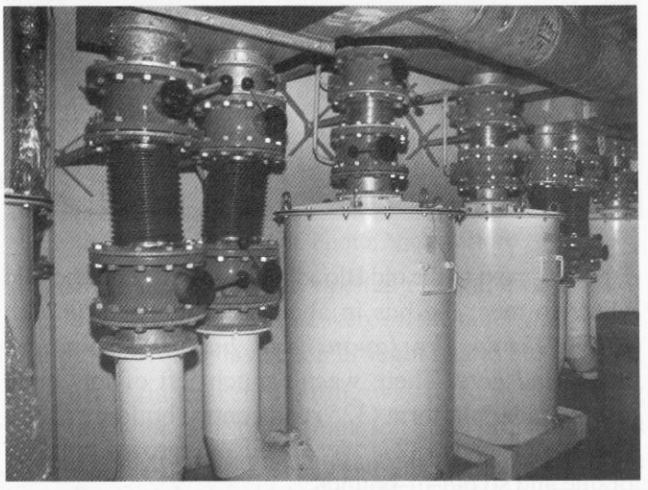
Inside the HAS

Although there was a not a huge amount to see inside there were some lovely little gems such as the white squares painted on the ground where the pilot, navigator, NCO and guard stood. There were also yellow arrows pointing to where the Tornado front and rear chocks were to be placed. The jet exhausts were quite impressive, looking like something out of a sci-fi film.

Briefing rooms

Pilot's briefing building. Photo: Nick Catford

After a demonstration of the doors opening (and squeaking!) we headed back into the misty rain and onto the Pilot's Briefing Building. This was another hardened but surface building finished in rust-coloured concrete. This was one of two such buildings on the base where pilots and navigators were informed of their next mission. Inside was in a relatively good condition and contained rooms where the pilots would dress, as in the QRA area. The filter room looked immaculate and still had all its equipment as did the generator room, always a nice bonus.

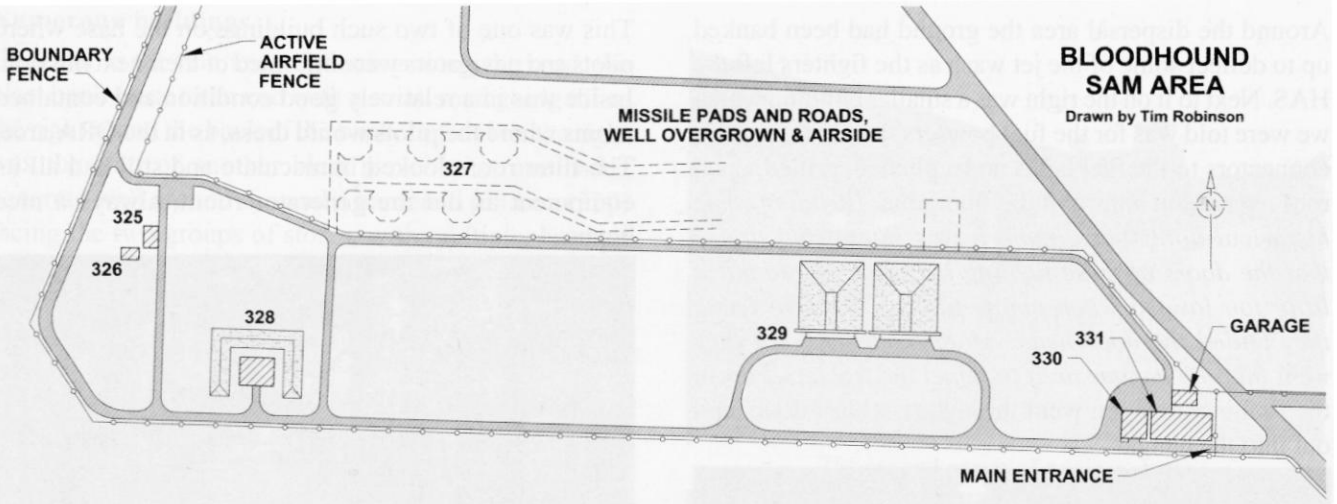


Immaculate filters in the Pilot's Briefing Building

Mission rooms were bare apart from a military-green computer console that gave you an idea of how the room was laid out. Some kind of indicator light box was still on the wall in the main room though the front panels showing what the lights meant was gone. In the connecting corridor was the airlock control panel with a small piece of paper stuck on the bottom saying *NBC BLACK Turn timer to 3 minutes*. The timer dial at the top of the panel had two red 'dymo' tape strips saying *DO NOT ADJUST & SET TO 3 MINUTES*. Interestingly the timer dial did go up to 10 minutes – maybe they were hoping to get a bit more notice of an impending attack! Next to the panel were three 'velocity monitor' boxes with gauges from 0 to 2000 ft / min and alarm lights made by a company in High Wycombe, UK.

By now, the weather had perked up considerably and Hal and our bus driver needed some refreshments so after a drive round the end of the runway we were

Bloodhound radar platform and building



deposited next to the old Bloodhound missile site and told where to meet the bus in about 30 minutes. *The plan above shows the layout and building numbers mentioned here*. There wasn't much left of this area, just the radar platform (325) and control building (326). The launch pads (327) were well overgrown but also airside and so out-of-bounds.

Wandering down the main road a lot of us commented on the length of the conveyor belt in the adjacent gravel works – we couldn't see the start or finish! The old missile arming building (328) was firmly locked shut but you could see the earth blast bank around three sides. Further on there were two more munitions stores set back on a separate road loop (329), a services block (330) and finally the office / hardened guard house (331) at the main entrance. Inside this were some surviving artworks showing Bully (*Bullseye* TV programme), a dog-fight between a Spitfire and ME109 and a lion dressed as a king with a Ford blue oval (no, I've no idea either!).

Towards the Command Bunker

Having got to the gate with time to spare we turned right and sauntered along to a set of hangars and a dismantled wooden radio mast whilst thoroughly enjoying the view of landing planes due to our proximity to the end of the runway. Eventually we met up with the bus again, boarded and headed over towards the Command Bunker. Passing a large hangar we made a brief stop for some photos and Hal pointed out the second pilot's briefing building just across the way. This was finished in the same rust-coloured concrete and as far as we could make out, looked the same externally.

The Command Bunker was built much like a HAS but with corrugated, faceted sides and cast concrete ends. There were external buildings for generators, an entry / exit point and four tall radio masts set at each corner. We had about 45 minutes here so all disappeared in different directions, bumping into each other at various points. Once through the entrance the corridor led into the generator room, again with plenty of equipment still in place. From there I found myself in the secure guard area with bullet-proof glass screens and a wooden security desk.

On the other side of this was a small corridor where you would deliver documents, etc. but not gain entry to the bunker as there was no door. In the same corridor there was a staircase which led up to the first floor but again only to a document hatch, bullet-proof screen and no

Two-level control room. Photo: Nick Catford

means of entry. Heading further into the bunker, the corrugated walls were clearly visible so there was no intention for this to be hardened. Various offices led off to the left and right before arriving in the double-height Ops room.

Although there was no lighting, torchlight still showed what an impressive space this was. A large console ran centrally along its full length with smaller versions in the rooms off to the sides. Although there were no computer screens in this it still looked superb as did the situation wall and raised walkway the operators would be facing. Above this wall were the status lights split into two banks; on the left a series of unknown codes and the right more understandable ones such as *ALL CLEAR NBC, MSKS ON, SINGLE HAS, AIR ATT* and *FIRE*.

To the left of the walkway was a ladder leading up to the gallery above, which looked across to the glazed observation area. Standing all alone on this landing was another control panel which upon closer inspection, was found to be for the airbase lighting with buttons for *RUNWAY 27, SOUTH TAXIWAY* and *QRA* amongst others.

Moving round to the side of the balcony, there was a short, narrow walkway leading into the glazed observation area. Another console ran the full length of the windows, empty apart from the *STATION SIREN CONTROL* panel which had three simple buttons marked *ALL CLEAR, CONTAM "BLACK"* and *AIR RAID "RED"*. Behind it was an island console and on a couple of the walls there were the private telephone hoods. A small Lamson tube system was used throughout the bunker and a station was in one corner of this room.

Heading back towards the entrance but on the first floor there were several offices and rooms with map boards and pull-down projector screens. The last office had the document drop-box and bullet-proof glass screen I'd found at the top of the one-way staircase and next to it was another Lamson station. Time was now pressing so it was back down to the ground floor and a quick look in the service entry and telecoms frame room. Nothing much to see apart from some cabinets, the frame and a few scrap items that hadn't made it off-site

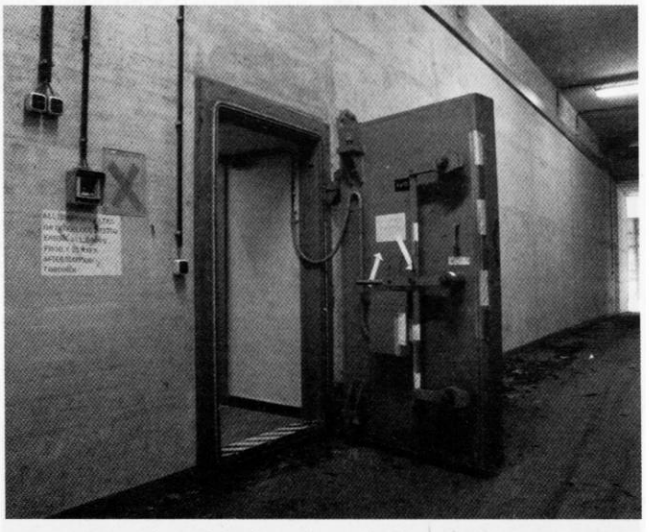
Outside the group was slowly gathering again. Our next destination was the Avionics Bunker but as Nick had already seen that on an earlier visit he had elected to stay in the Command Bunker where he was guaranteed to have "NO LIGHTS!". The rain was making another appearance so it was good that the walk from bus to bunker was short.

The Avionics Bunker

The Avionics Bunker or Protected Avionics Centre looked huge from the outside but was effectively one bunker inside another for protection. Walking up a small rise in the ground we arrived at a covered double-height lobby with a long spine corridor leading off it. A third of the way along the corridor, it opened out and a large blast door with an overhead hoist were on the inner wall where equipment would have been brought in and out.

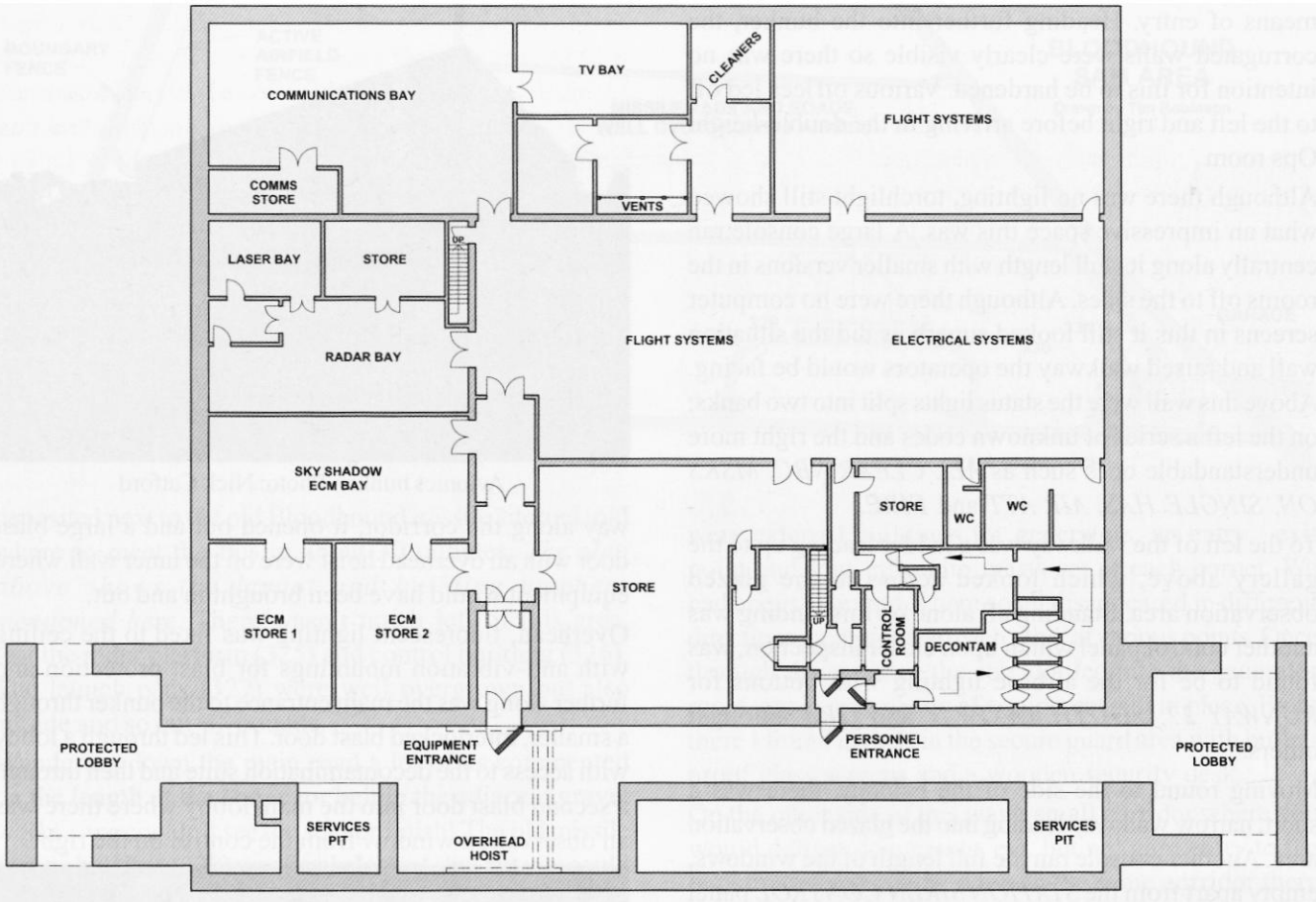
Avionics bunker. Photo: Nick Catford

Overhead, fluorescent lighting was fixed to the ceiling with anti-vibration mountings for blast protection and further along was the main entrance to the bunker through a smaller, interlocked blast door. This led through a lobby with access to the decontamination suite and then through a second blast door into the main lobby where there was an observation window from the control on the right.



Blast door into the Avionics Bunker

Unlike the bunkers we have seen in East Germany, decontamination had four walk-through corridors – probably no more than 4ft x 12ft – off a general changing room. These had a small gutter-like trough along one side which we could only surmise held the Fullers Earth that was mentioned on labels in the shoe-cleaning grates in the floor. Once through the corridors we were into another changing area and then out into the bunker corridor. This ended in a huge room that ran two-thirds of the length of the bunker and because of its size, was quite difficult to visualise how it was laid out. According to a plan we later found on the wall in the basement, this was split into two areas, *FLIGHT SYSTEMS & ELECTRICAL SYSTEMS.*



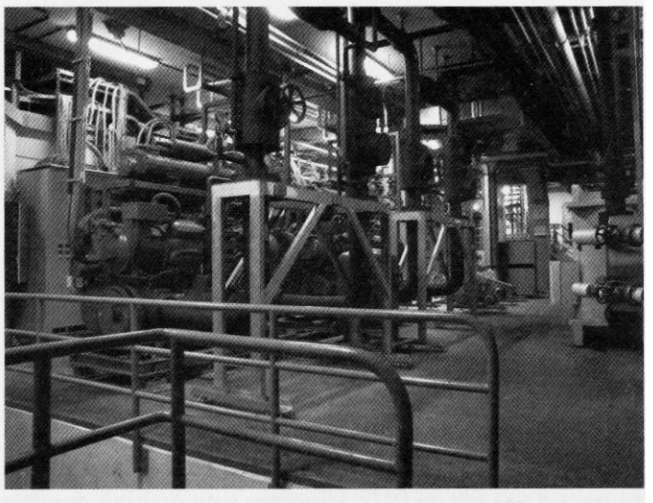
PROTECTED AVIONICS CENTRE - GROUND FLOOR PLAN

Drawn by Tim Robinson

The 'Flight and Electrical Systems' room

Off this main hall were several other large rooms for *RADAR, SKY SHADOW ECM (Electronic Counter Measures), COMMS & LASER BAYS* as well as one with a bank of ventilation grilles reaching to the ceiling. The only equipment left on this floor were the a/c ducts and fan units plus the usual electrical switch panels although the bunker was still live as there was power and lighting throughout.

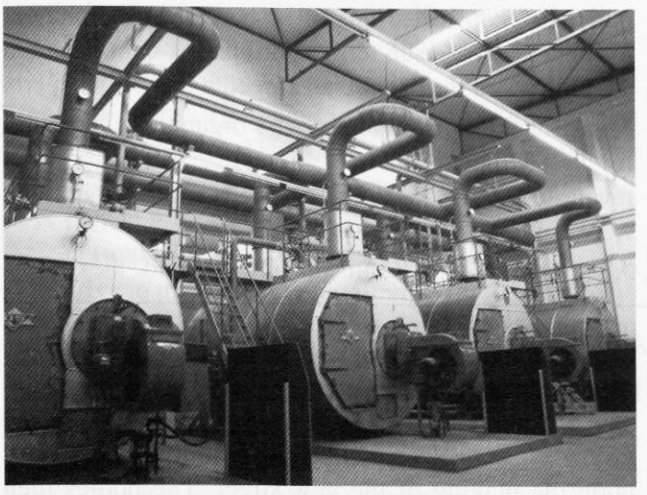
A real treat lay in store for us in the basement as no equipment had been removed from the plant room. Quite apart from its size it looked like it would all function perfectly if the switches were flicked – even the control panels had every dial and gauge still in place! Off to one side was the filter room with fans on the upper level and on the lower half level, rows of filters and a control panel. Again, it was immaculate and complete.



The impressive plant room

We still had a few other things to see including retrieving Nick from the Command Bunker so our time was nearing an end. Nick had completed his photography when we arrived back and as we were now reasonably close to the museum and the sun had made an appearance we bade farewell to our bus and driver and took the short walk to the heating plant and generator building. This, like most of the other large buildings on the base, was

painted matt-finish NATO military-green and consisted of a tall chimney now sporting mobile phone emitters, two large circular water tanks and the main boiler / generator house. Stepping inside was another revelation as the four boilers were all in place and huge!



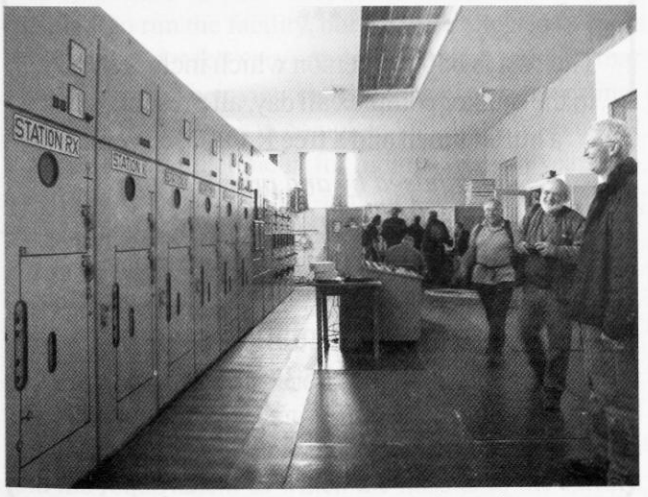
The boilers still in place

One generator still works

In the adjacent hall, three generators stood proudly looking on and for a minute when Hal said "did we want to see one working?" I thought he was joking. This was quickly dispelled as he started pushing switches, pressing buttons and then asked if we were all ready. Lo and behold a whoosh of compressed air heralded the start and slowly it burst into life.

Although "moths to a flame" can be over-used, in this case it summed up the scene perfectly as we all huddled round the engine pointing at various things. Hal could see we were thoroughly enjoying this so took the access panels off allowing us to watch the cams and oilways at work. What a treat!

Looking out onto the generator hall was the control room with a beautiful old-style panel and big cabinets showing the various sub-stations around the base and their connections into the site grid. Usually these rooms are stripped bare and you just have a black and white photo but here was the real thing for all to enjoy.



Lovely old generator control panel

The humidity had dropped a little by the time we were back outside so the walk to the museum was very pleasant. En route we came across a train on some track which we thought may be part of the Accident Training Centre that currently uses some of the base. The cab door was open so in true investigative style we climbed aboard for a look-see. In reality though, we all just wanted a moment as an engine driver!

Laarbruch's on-site museum

Passing disused barracks and married quarters we finally got to the museum which is housed in the former St Peter's Church. It was clear they were taking no chances with unwanted Sunday parishioners by placing a Bloodhound missile and 4-barrel anti-aircraft gun outside the doors!

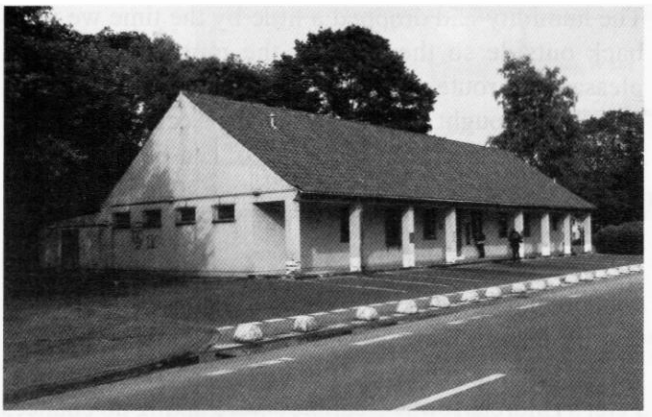
This was a welcome stop and a chance to unwind a little as we'd been on the go since leaving the arrivals hall. Even lunch was grabbed between buildings! The museum is very good, giving plenty of history about the base together with photos from its active days. Dioramas and cockpits are also there as were two memorial stained-glass windows – one for 16 Squadron from 1915–1990 listing the battles they fought and in memoriam to three servicemen, the second for RAF Laarbruch itself listing the squadrons based there and again in memoriam to three servicemen.

The museum deserved far more time but we were nearing the end of our day and only managed about 30 minutes before we had to think about going. Bidding farewell to Hal and thanking him for a superb day, we split up heading for various destinations but ultimately, the departure hall.

Bob, Chris and I took a short walk past the sadly locked, Astra cinema to the main guardhouse and police station. Opposite the main entrance on the other side of the road were some of the married quarters which Steve, Richard and Paul had gone to see elsewhere.

The old cinema

After a quick detour to the empty NAAFI building we wandered down the main road back to the airport. As a final aside before we tucked into a well-earned meal, the terminal building was once the maintenance hangar



The guardhouse at the main base entrance

– known as One Hangar – for the various fighter units. You could easily see a bustle of personnel working on planes as they were brought in from sorties with various issues. We didn't have enough time, but in one of the restaurants there are photos of the hangar in its former glory. Hal confirmed this as he had taken the photos! Sitting out on the sun terrace, drinking a cool beer and chatting about the day, we all agreed it had been superb.

Many thanks to Hal Palmer who organised everything for us and made our trip fantastic. Were there any favourite bits…? Well, the beginning, middle and end were quite good!

All pictures by Tim Robinson, unless stated.

From The Archives

Flooding of the Metropolitan Railway Tunnel during construction, London

Since the sinking of the Fleet ditch between Ray Street and Saffron Hill, great fears have been entertained by the contractors for the safety of the Metropolitan Railway tunnel and brick arching in that district. From Clerkenwell Workhouse along Victoria Street the tunnel and arches run parallel with the Fleet sewer, created about seven years since. These fears have been fatally verified. The heavy rains of Sunday last have caused an immense accumulation of water in the sewers, which gradually found its way into the tunnel. At an early hour on Wednesday morning, it was discovered that there was about twelve feet of water in the tunnel, which was forcing its way through the sides of the brickwork. The bricklayers were at once ordered to desist from work, and a number of men lowered into the tunnel in baskets, with the object of breaking holes in the sides of the tunnel to allow the water to escape.

After this operation had been going on for some time, some portions of the foundations of the arches were observed to be giving way, and the men were at once hauled up from their dangerous post. Scarcely had the last man reached the surface than the whole mass of brickwork and timber appeared to be bodily lifted up in the air, and fell into one heap of ruins. Several hundred yards of tunnelling and arches were totally destroyed, while the water was flooding the ruins in all directions.

The scene presented the appearance of a destructive earthquake. The water came pouring down from the high level in torrents, flooding that portion of the tunnel still remaining standing, destroying the gas-mains in Ray Street, inundating the cellars of houses, and appearing to have uncontrolled power over the whole portion of that low-lying district. The destruction of property is very great, and the accident will cause a delay of three months in the opening of the railway.

During the night, great quantities of earth, brickwork, and timber were constantly falling. Immediately on the spot where the accident has taken place was situated the burial ground of St. Peter's, which was removed consequent upon the making of the new street. The bodies then remaining in the ground were collected and placed in a mausoleum, erected on the spot, in an excavation purposely made. On Wednesday night this building was struck by the falling timbers of the railway, and the upper portions of the walls shattered to pieces, while the lower part was flooded by water, and many of the bodies were washed out into the open excavation, presenting a most sickening sight.

SOURCE: ANON, 2009, Floods damage Metropolitan Railway tunnel. *The Guardian*, 20 June 1862.

Hack Green Open Day
Saturday 19 March 2010

This event will mark the 20th anniversary of the ROC stand-down. The early warning siren will be activated & the massive Marconi radar array will be operational all day; the bunker will be disconnected from the national grid & will be running in full "Fallout" operational condition.

***

The cost is £30 per person which includes entry to the bunker complex all day, all presentations, a buffet lunch and a free R.O.C. souvenir.

Organised by and proceeds to the Hack Green Bunker.

To book, please find the booking form on the Sub Brit website.

For more information phone: 01270-623353 or email: coldwar@hackgreen.co.uk

Or see the website on: www.hackgreen.co.uk

Underground in Arizona, New Mexico and Texas – Super-sized in the States

by Gavin Saxby

On the road

It's Sunday 10 October 2010, the sun is low in the sky, but the temperature is still in the 30s. Your intrepid author is walking through the rental-car terminal at Phoenix Sky Harbor airport trying to find his car. A heart-stopping moment – there's a gorgeous looking convertible in what looks like my space. Damn, it's not for me. My own car is a more modest Nissan hybrid, not necessarily what I'd have picked for a 1,700 mile road trip between Phoenix, Arizona and Houston, Texas, but it'll do.

The drive to the hotel is entertaining – they drive on the wrong side of the road here along six-lane freeways and intersections appear randomly on both sides of the carriageway. But it's not just roads that are big in the United States; I had a list of some huge man-made and natural underground spaces to cover in my next two weeks. The itinerary had been put together after a shorter previous visit and discussions with Martin Dixon who had covered many of the sites earlier in the year.

Day one dawned hot and bright. My first port of call for the day was due to be the Arizona Mining and Mineral Museum[1]. Sadly, I had not bargained on the museum being shut for Columbus Day. The museum has over 3,000 specimens and mining artefacts on display and I'm sure it would have been very interesting had it been open! Next on the list was the Hall of Flame[2], a museum containing over ninety vintage fire engines dating from 1725 to 1969. The museum is a fascinating place for any fire-fighting enthusiast and I spent over three hours there looking through the exhibits which included several British engines.

A long drive was on the cards, several hours through Arizona down to Tucson. I chose to drive via Oracle to visit Biosphere 2. It's a three-acre, artificial, closed environment originally designed to run scientific experiments in carefully controlled conditions.

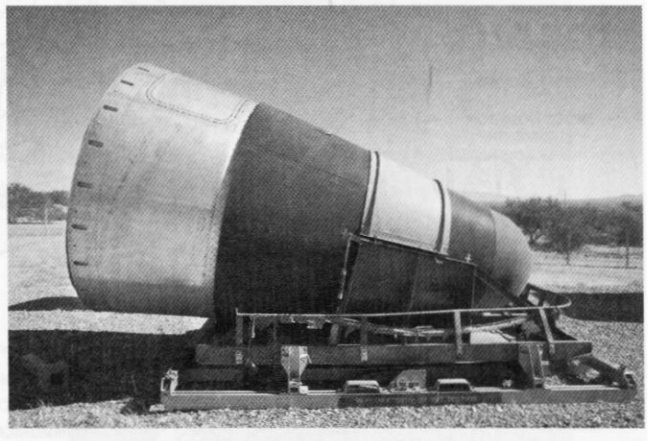
The tour proved to be absolutely fascinating – the only underground element was the basement containing all the plant to run the facility, but we were allowed to walk through it and it felt very similar to modern bunkers that I have been in. Their view on redundancy was interesting; when the facility was in complete lockdown no external contractors could come in for months or even years. To combat this they had 26 air-handling units; if one failed, they simply moved on to the next one!

Titan 2

0630hrs on day two. Ugh. I wish this time of the morning didn't exist. Still, it felt worth it, six hours at the Titan 2 Missile Museum[3] just south of Tucson beckoned! Almost from the start the limitations of the original Titan and Atlas ICBMs were apparent. Non-storable propellants and the requirement to winch the missile to the surface before launch meant that launches took time and left the missile vulnerable to attack for too long a period. The Martin Company produced a design for Titan 2 which could carry a larger re-entry vehicle over a longer distance and that could be launched direct from a silo. Titan 2 entered service in 1963 and remained in use right up to 1987.

The museum runs special 'Top to Bottom' tours around twenty times a year, during the cooler parts of the year (May-June and September-December). This special tour takes around five hours and allows you to visit every level of the silo and control centre. Our day started with some time in the classroom to take us through the history of the American missile program and then it was out into the heat to tour the surface features of the silo. The silo is covered in a 760-ton blast door; this massive structure protects the silo from up to 300psi of overpressure and could have been pulled open in just under 19 seconds, quite a feat.

The surface features have been slightly altered since the site was decommissioned, as the agreement that enabled the silo to stay open as a museum requires that the silo door be blocked half-open and that a small hole is cut into the re-entry vehicle so that satellites can overfly the site and verify that the missile has not been re-armed. When the silo door was blocked open, a stand was constructed so the public can stand on the surface and look down into the silo to see the missile lurking within. It really is quite a sight. Titan 2 carried America's most destructive warhead, nine megatons according to most sources. It is this massive payload that kept Titan 2 running until 1987 – the more modern Minuteman 3 missiles have a comparatively small 330 kiloton warhead, but their more accurate guidance means they can be used for surgical strikes against specific military targets.



The Mk VI re-entry vehicle

Evidence suggests that Titan 2 was designed to destroy deeply buried enemy targets. These would be command and control bunkers and the like, but at decommissioning time all the targeting information was pulled back to

Strategic Air Command and individual targets were never revealed. Missile crews did not know what the targets were anyway – the coded launch messages only gave a target number and no details of what it was. The sets of target data were put into the guidance computer on Mylar tape adding another layer of obfuscation.

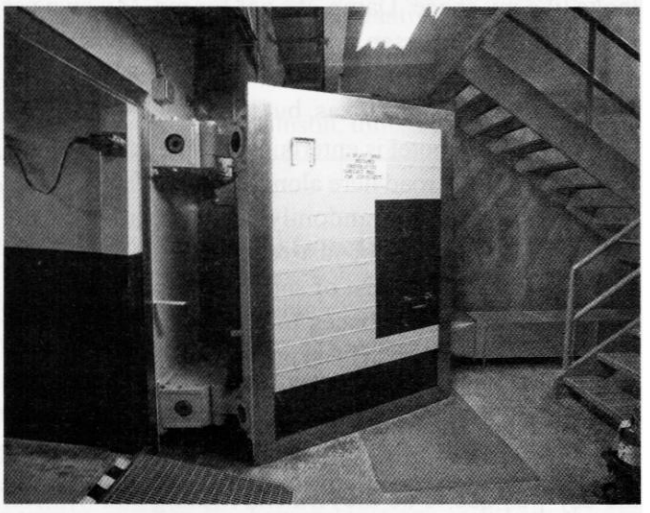
The surface tour showed us the fuelling and conditioning trucks that would have loaded the fuel and oxidiser into the missile. The fuel was Aerozine 50 (a 50/50 mix of hydrazine and unsymmetrical dimethylhydrazine) with a nitrogen tetroxide oxidiser. As well as being incredibly unpleasant on their own, the two substances are hypergolic (they ignite on contact with each other) and this presented quite a challenge to the propellant teams who had to fuel and unload the missiles.

Fortunately, unlike the previous generation of missiles, the fuel and oxidiser could remain on board in separate tanks in the missile for years without an issue. The propellant teams had to wear protective suits known as RFHCOs (Rocket Fuel Handlers' Clothing Outfit) to handle these dangerous liquids – they resemble space suits, and I can only imagine how hot and cumbersome they must have been to wear out in 40C+ heat of the desert.

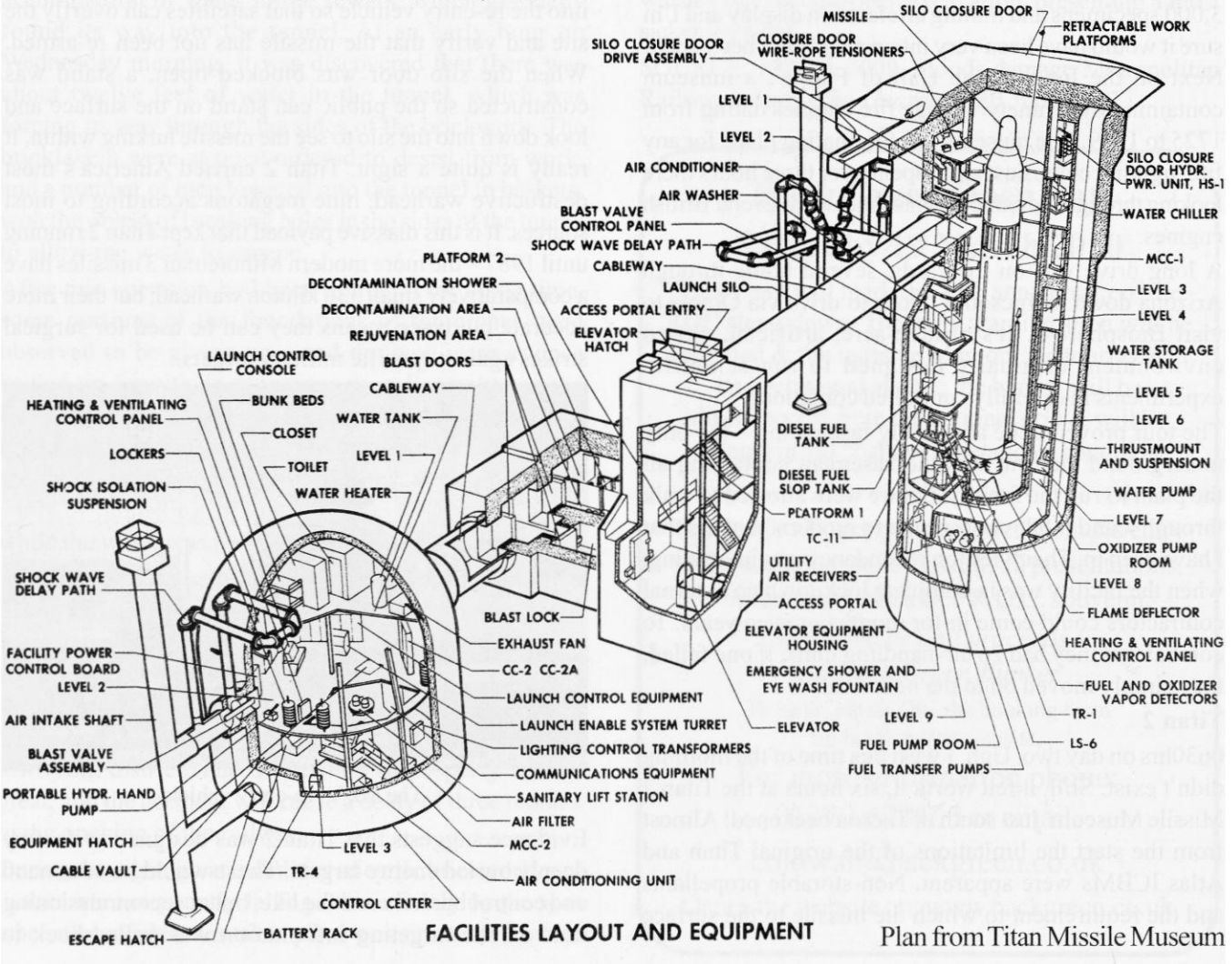
After looking down at the missile we were allowed to look at the hardened antennae within the compound and then it was on to the underground complex itself. The underground part of the site consists of three main areas, the access portal, the Launch Control Centre (LCC) and the silo itself.

Into the silo

We entered through the access portal and went down the stairs to be greeted by the main blast lock. The blast doors weigh approximately three tons but move easily with a push thanks to being perfectly balanced.



The outer blast door

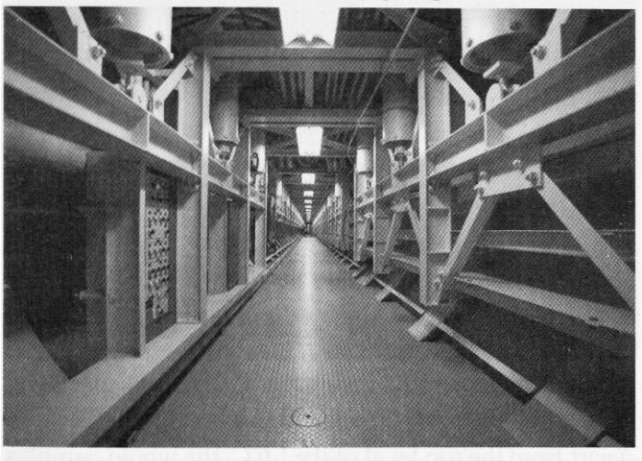


FACILITIES LAYOUT AND EQUIPMENT

Plan from Titan Missile Museum

Plan from Titan Missile Museum

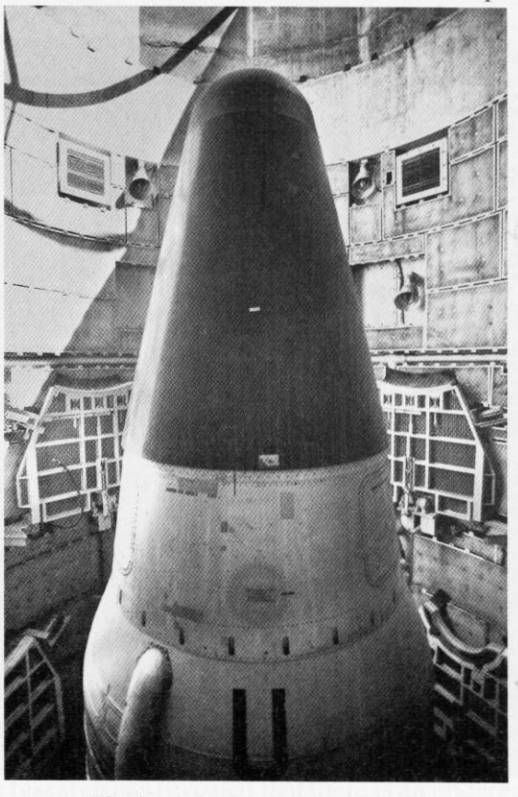
Just about every cable or piece of equipment is suspended on springs to allow it to swing in the event of a nearby bomb burst and subsequent ground heave. Distribution boards have large service loops of cable so they can move freely. Turning right out of the blast doors leads into the 43-metre-long cableway going to the main silo.



The cableway between the silo and the LCC

All the way down the cableway there are regular breaks for service loops on the cables to allow the tunnel to shear if necessary. The cables are run inside a framework which is suspended from the cableway. The ends of the cableways are flexibly linked to the silo, access portal and LCC.

Once in the silo we were allowed to see every single level. We started at the top, viewing the very top of the re-entry vehicle. Levels are numbered from the top down.



The business end of the missile

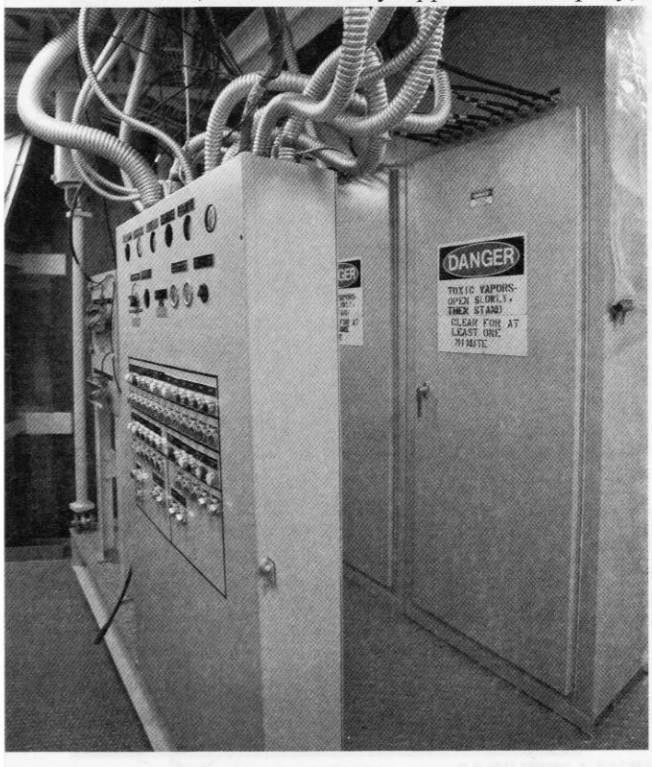
On level one of the silo we were able to see the large hydraulic accumulator and drive system which provides the motive force behind the moving massive launch duct door. Moving down through the silo we were able to see everything there was to see. Level two houses part of the water-chilling equipment (the launch duct was kept at a constant temperature when in use) and the original optical calibration equipment for the missile guidance system, which was rendered obsolete in 1978 when the missile guidance computer was upgraded.

We used the lift to move between the levels and down on level three we saw the 510HP diesel generator, capable of providing 350kW should the external power grid fail. Interestingly, it was started by using compressed air instead of batteries, apparently for reliability reasons.

This level also has an inspection hatch in the floor which gives access to the huge water tank which runs from the top of level three to the bottom of level seven. The tank contained 380,000 litres of water. This water was sprayed beneath the missile during launches where it acted as an acoustic dampener to take energy out of the exhaust blast and prevent damage to the silo. The water could also be used for fire-fighting.

Level four is a more sparsely populated level, containing only an air-cooling system. In common with almost all the systems in the silo, it is mounted on a suspended plate to give it shock resistance. Level five contains more air-conditioning equipment and a 9500-litre diesel tank used to fill the 200l day tank for the generator on level three.

Level six housed several important pieces of equipment, firstly the apparatus that monitored the silo for leaks of fuel and oxidiser (known as the MSA from the name of the manufacturer, the Mine Safety Appliance Company).



The MSA

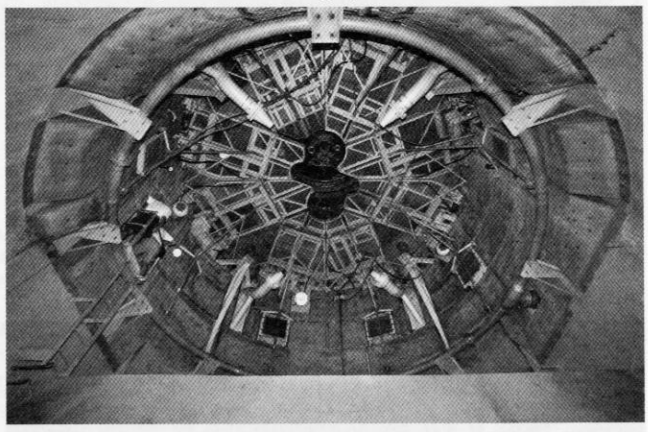
This level also contained another hydraulic system and the foam generation system for fighting diesel fires on the level above. If Chuck Penson's excellent book on the silo[4] is to be believed, the foaming agent used was ox blood – a fact that came as something as a surprise!

Level seven is concerned with water pumps for fire-fighting, domestic supply and water chilling and also houses the compressed air system. At this level it is possible to stand by the missile at the level of the first stage engines. Looking up at the missile and the silo from here was particularly impressive:

If you look at the picture, the foreground shows the large thrust mount on which the missile sits, held by explosive bolts. The ring is suspended from very large springs and dampers, giving the missile some protection against ground heave. Shortly before launch the mount had to be fixed, leaving the missile vulnerable to shock for a short period of time.

Level 8 originally contained permanently installed oxidiser and fuel offloading pumps, but after 1979 they were removed and only installed as and when they were needed.

Level 9 consists of the sumps and the massive concrete flame deflector that would have sent the exhaust plume back up to the surface. We were allowed to climb down the metal staples to get to the very bottom of the W (as it was known, due to its shape).



Looking up at the platform on level 7 from the bottom of the W.

The Launch Control Centre

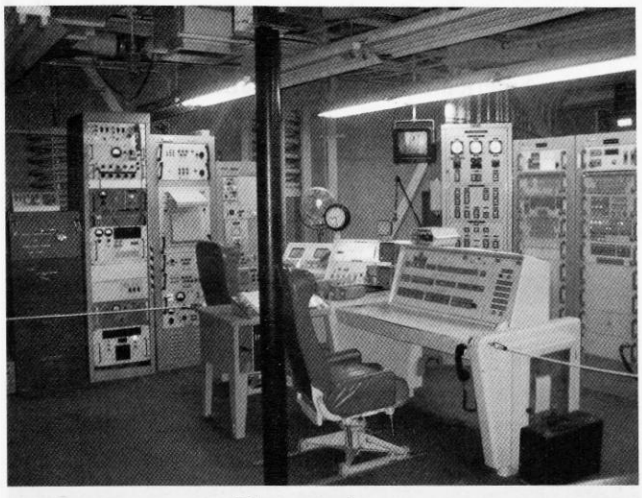
From here we travelled back up in the lift to level two and then moved back down the cableway to the Launch Control Centre (LCC). The LCC has three levels, the accommodation at the top, the control room proper in the middle, and the equipment room at the bottom. Crews worked 24-hour shifts inside the complex so space was needed for sleeping, eating and showering.

Apart from the top level of the LCC, the whole complex was a 'no lone zone'. This meant that each crew member had to be in sight of another crew member at all times to ensure that no single person could sabotage the complex and, given the hazardous nature of the site, that there was always someone to go for help in the event of an accident.

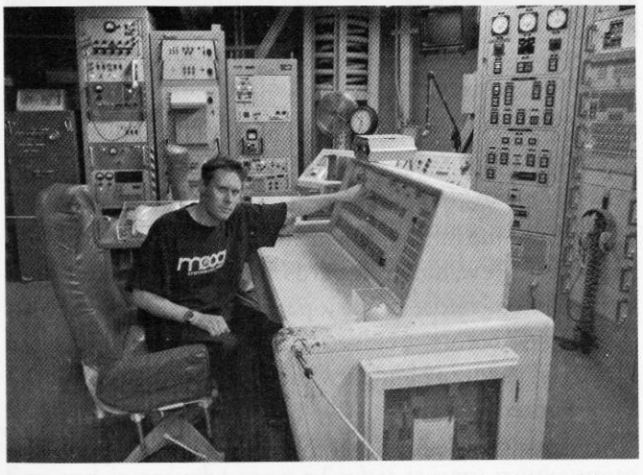
In the control room we went through the entire launch

procedure, right down to turning the twin keys that would have launched the missile and put a 9MT crimp in someone's day. This is part of the standard tour too which although much shorter is still well recommended. I was lucky enough to get my photo taken in the commander's chair with my fingers on the key that one day might have had the power to end the world as we knew it – quite a feeling.

Trying to describe the vast array of equipment in here is beyond the scope of this article – if you are interested in finding out more I recommend buying either The Titan 2 Handbook as previously mentioned or a copy of David Stumpf's Titan II book. Suffice to say that it contains all the equipment to monitor both the missile and the silo and its facilities as well as guidance computing, launch controls, the safe containing the Emergency War Orders, hydraulic equipment and weather monitoring facilities.



The control room



Your author tries not to grin maniacally with his hand on the key switch

We were then allowed to look in the lower level of the LCC which contained vital radio and telephone communications equipment and power distribution.

Having visited both SS-4 and SS-5 silos in Latvia and Lithuania I was immediately impressed by the Titan 2 silo and how much more advanced it felt. Titan 2 is contemporary with both SS-4 and SS-5. In fairness, all the Soviet missile silos I have seen have been stripped out but even without the equipment they seemed very primitive in comparison, with the launch ducts seemingly only being metal tubes in the ground with thin, domed concrete roofs. If I needed to shelter from a missile attack, I would certainly prefer to do so in a Titan 2 silo!

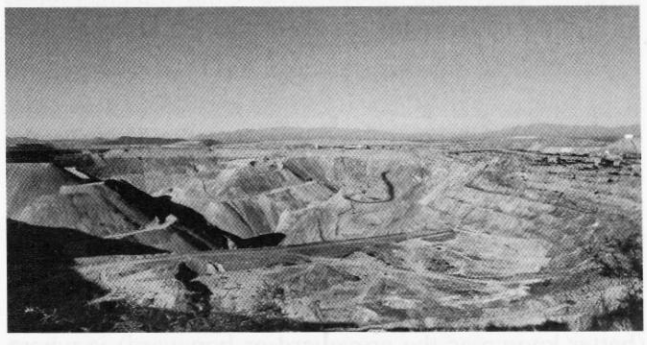
I had a stunning time at the museum and would wholeheartedly recommend it to anyone. There is so much to see in Arizona that you could easily spend a week in the area to justify your silo visit.

I'd like to thank all the museum staff and especially Chuck Penson for his help in putting this section of the article together.

Lodes of Copper

After a late lunch on the hoof I drove back up Interstate 10 to the enormous ASARCO Mission copper mine[5]. The mine runs tours each day and I managed to get a spot on the last tour that day – I was very lucky that there wasn't a single other person there so I ended up with a private tour!

The site really is vast; the tour is run on a bus and it took several minutes to drive from the visitor centre round to the other side of the complex where I was able to get out and stare down into the pit where the trucks were busy working. The pit covers around 2,000 acres of land, just ten percent of the total operating area of the mine. The tour bus stopped at a viewpoint on the hill overlooking the pit; from there it was approximately two miles to the far side of the mine.



The opencast pit as seen from the viewing point

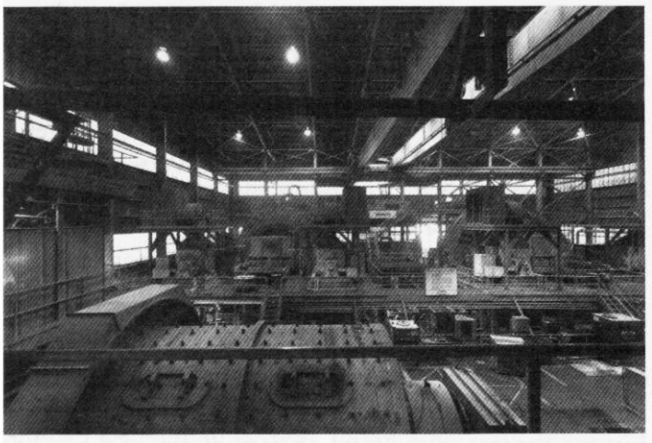
The shovels used in the mining operation are massive; each scoop contains up to ninety tons. They are powered by electricity, and substations are moved around the pit to provide 4,160 volts to wherever it's needed. The shovels take rock from the working face and drop it into the haul trucks. The largest of these trucks can shift 320 tons of rock in a single load. The trucks are a diesel/electric design with a 2,700 HP engine driving a generator that powers the rear wheels of the truck.

The rock is loosened by drilling and blasting – the mine uses electric drills to put 50-feet-deep holes spaced every 25 feet along the ore body. These holes are packed with around 1,000lbs of ammonium nitrate and fuel oil (ANFO) and then detonated 60ms apart to break up and loosen the rock rather than moving it.

More research has revealed that there is an underground

mine on the site as well. It consists of five or so miles of drift around eighteen feet square and about 3,000 tons a day is excavated from underground. This ore has an assay of between 1.5 percent and 5 percent copper and is blended in with the rock from the opencast mine to feed the mills with a higher-grade material.

The ore is processed on the site, through a number of steps including a gyratory crusher, ball mills and flotation to produce 28 percent pure copper which is sent to the smelter 85 miles away in Hayden, Arizona. The plant has the capacity to process 24,000 tons of ore a day and this yields between 420 and 460 tons of copper a day for smelting.



The processing facility showing a rotating ball mill

Day three was spent at the PIMA Air and Space Museum[6] in Tucson. There was nothing underground there, however there were plenty of Cold War era aircraft on display.

As well as the obvious such as the B52, it was great to see a collection of MiGs (15, 17, 21 and 29) and a display of Cruise Missile control and launch trucks. These trucks are the same type that the 501st Tactical Missile Wing deployed at RAF Greenham Common and there was a plate commemorating this fact. Part of the day was spent on a tour of the 309th Aerospace Maintenance and Regeneration Group (AMARG). This massive facility (better known as the graveyard or boneyard) is where the USAF stores aircraft for reuse or for spare parts.

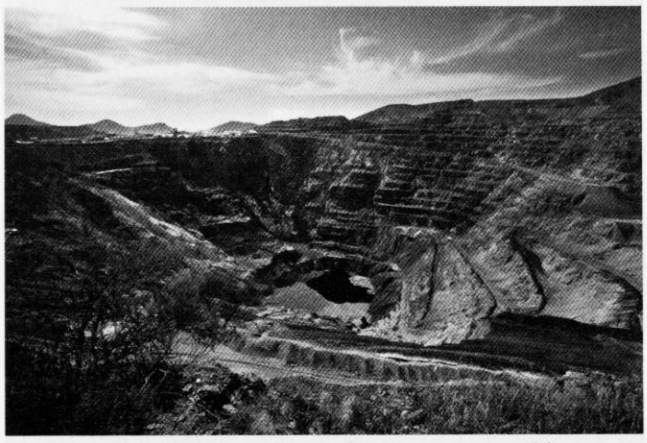
The low humidity and rainfall in Tucson combined with the hard desert soil (removing the need to pave the entire area before moving aircraft around on it) makes the area ideal for its purpose. The scale of the facility was quite stunning – the tour was done by bus but sadly we weren't allowed to disembark.

A Thor and a Titan II missile at AMARG

Into the hills

Day four saw me pack up and leave Tucson early to drive down to a mining town called Bisbee. Following the enactment of the General Mining Law of 1872 it became possible for prospectors to gain ownership of any mineral deposits they found and to turn a profit from them.

The first claim in the Mule Mountains (where Bisbee is located) was made in 1877 by soldiers from nearby Fort Bowie. By the end of 1879 more than one hundred claims had been staked and in 1880 Edward Reilly (a lawyer from Pennsylvania) bought the Copper King and Copper Queen mine claims and set about developing them properly. He secured extra funding from Judge DeWitt Bisbee and technical skill from Benjamin and Lewis Williams of San Francisco. For his investment Bisbee got his name on the new mining camp that was formed for the venture. By the 1890s the mine entered a period of rapid expansion becoming the fourth largest copper mine in America and Bisbee became the third largest town in Arizona.



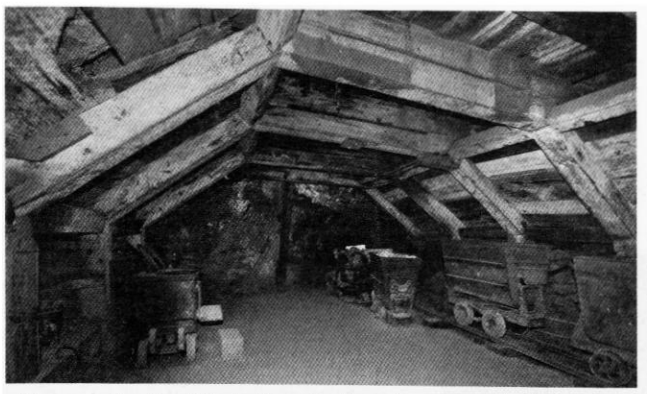
Lavender Pit, the more modern opencast working, now worked out

The Copper Queen Mine[7] offers tours of the underground workings and I managed to get myself on the next tour to leave. We were dressed up in slicker, helmet and lamp and entered the mine sitting astride small train carriages. Stopping a few hundred yards in we were taken up a flight of steps into a large stope. Our guide used to work in the mine before it closed and he took us through the history of the mine and how the very first miners in the area worked.

After this we rode further into the mine and stopped in a small area leading to one of the main lift shafts. The guide took us through the more modern history of the mine, the use of air-powered drills, horses and trains to pull the ore carts and how to drill a face for placing explosives.

All in all, a very interesting tour albeit slightly touristy. The rest of the day was spent on the long drive over to Las Cruces in New Mexico.

Day five was set to be a very long day indeed, driving from Las Cruces all the way to Carlsbad. I decided to



The area by the lift shaft; note the rail mounted mine privy on the left

drive via White Sands to visit the National Monument[8] there. On the journey I saw a sign for a Missile Museum and followed the highway exit, however, afterwards the signs completely dried up and I started to pass signs that indicated I was on my way to a classified facility, obviously the missile test range.

I was slightly unsure about ending up on a dead-end road and meeting a shouty man with a rifle so decided discretion was the better part of valour and that I'd just carry on to the National Monument as planned. My visit here was very interesting, walking across the dunes and reading about the wildlife.

The famous missile range at White Sands gets its name from this 275-square-mile desert of snow-white gypsum, the largest such deposits in the world. Once finished at White Sands I drove all the way to Roswell for a look at the International UFO Museum and Research Centre. After such a long day of driving I was glad to finally arrive at my hotel in Carlsbad a few hours later.

Carlsbad – probably the best cavern in the world

I arose before dawn on day six to get myself down to Carlsbad Caverns[9] in time for their first Ranger-led tour of the day which I had booked a few weeks in advance.

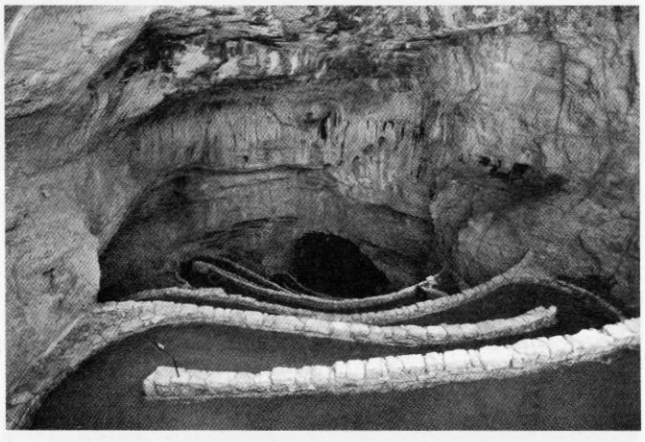
We were given candle lanterns and taken along into the 'Left Hand Tunnel'. The Rangers explained some of the history of these immense natural limestone caverns, how they were formed and the different kinds of formations we were seeing. The caverns started being created over 250 million years ago – at that time all the world's land mass was fused together in one large continent called Pangaea.

There was a large inland sea known as the Delaware Sea and it covered most of what is now southeastern New Mexico and west Texas and it contained much in the way of plant and marine animal life. Reefs formed at the bottom of the sea, constantly growing taller and larger and behind these reefs lagoons formed. Over millions of years layers of limestone and siltstone were laid down.

Over time the Delaware Sea became isolated and evaporation caused it to dry out leaving solid minerals behind. Millions more years passed and this layer became covered in rock to a depth of over a thousand metres. Tectonic forces pushed all of this upwards, the sediment eroded away and it was left looking very similar to how it looks today. Underneath all of this were significant deposits of oil and natural gas and as tectonic forces cracked the limestone, hydrogen sulphide-laden water was forced upwards through faults.

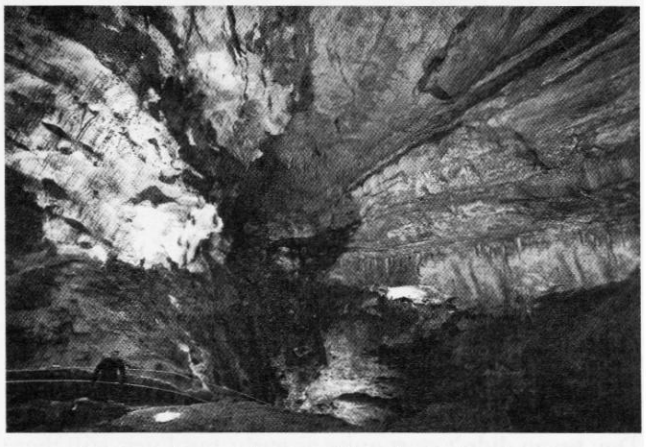
As this water met with rainwater coming down from the surface, sulphuric acid was formed and this very quickly ate away at the limestone and created the enormous chambers. More recently (500,000 years ago) surface water (weak carbonic acid) moving through the cave began to dissolve and redeposit calcium carbonate formations and they decorate the cavern to this day. The Rangers did a great job of making all the geology interesting and I felt it was a good start to my two days in the caverns.

After finishing the tour I headed back up to the surface in the 230m lift, picked up my tripod and headed back into the system through the Natural Entrance trail.



The Natural Entrance

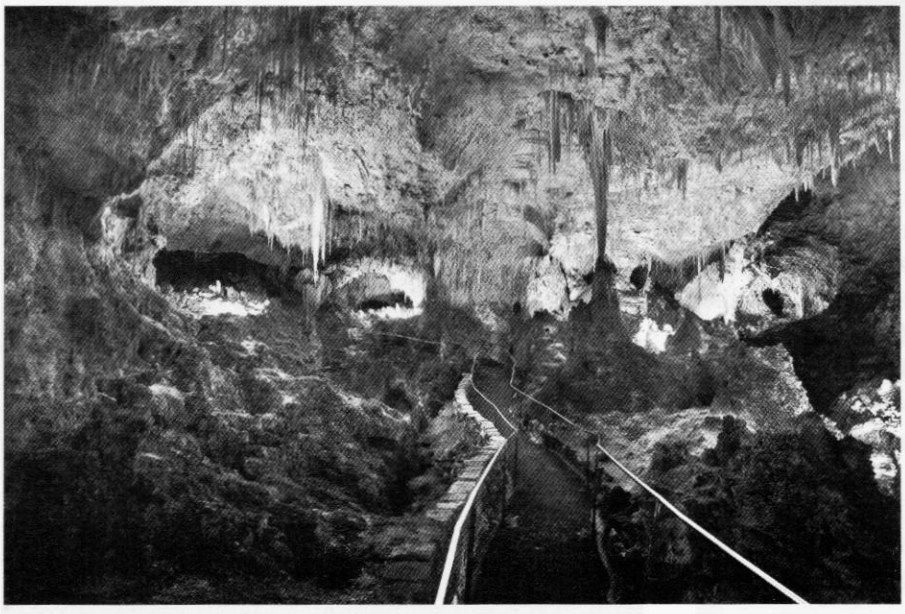
This is a one and a quarter mile walk from the surface right down into the main cave system. Describing the scale of the cave is very tough, and photographs don't really do it justice. I was completely awestruck looking down at the trail snaking deep down into the cavern while the ceiling soared hundreds of feet above me.



Your author trying to add scale to the picture

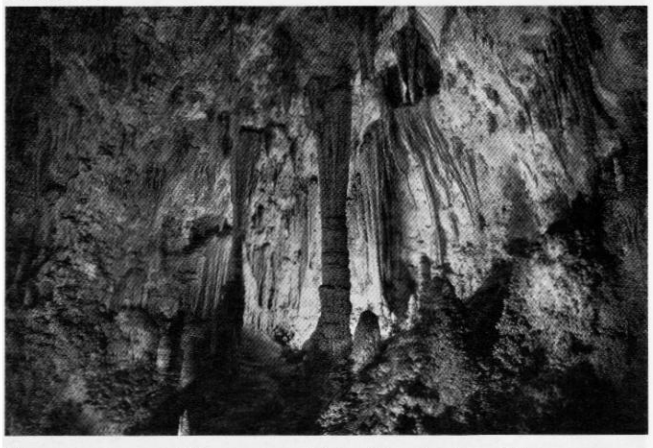
After spending several hours walking slowly down with my camera and tripod I was finally down in the so-called Big Room and decided to stop for a sandwich. I spent

the rest of the afternoon slowly walking around the Big Room (which is around six acres in area and in places up to 75 metres high) and taking more photos. The calcite formations were in the main absolutely colossal, and it was very hard to get anything into the photos that gives a sense of scale. Some of the stalagmites were tens of metres high.



A small part of the Big Room with railings for scale

All kinds of formations were represented: stalactites, stalagmites, curtains, straws, aragonite. Perhaps only the Americans would install a normal passenger lift to ease access but this does make the system accessible to those less able.



Time was marching on and I had to start making my way out of the system before it closed. I stayed on at the site for another hour to watch the Mexican free-tail bats that live in the caves exit the system for the night. They came out pretty much on cue at 6pm – the sky was absolutely thick with them. Sadly photos aren't allowed when the bats come out, but it was a very impressive sight indeed.

World Heritage, Kings and Spiders

Day seven didn't start quite as early, but I was still there in time for the Ranger-guided tour to King's Palace. This tour was all on paved walkways and wasn't challenging in the slightest, but we were given a lot more of the history of the cave and how it was discovered.

There is evidence that American Indians used the cave, however, they only came in as far as daylight reached. The first person to properly explore the cave beyond the light barrier was a 16-year-old Texas cowboy called Jim White in the late 1890s. The story goes that Jim saw bats rising up out of the cave mouth at dusk, but because he had never seen bats before, believed something was on fire in the distance.

He was a fence builder for the reservations by trade and used his skill to fashion a crude ladder and climbed down into the caves. Over the course of many years he kept going back and discovering more and more of them. He struggled to make people believe his tales about massive calcite formations but in 1916 he convinced local photographer Ray V. Davies to enter the cave with him and from that point on the future of the cave was assured.

Due to publicity work by White and Davies in 1923 the cave was scheduled as a National Monument by the then President of the United States, Calvin Coolidge. Following articles in *National Geographic*, professional interest in the cave grew and in 1930 the cave and land around it became designated the Carlsbad Caverns National Park. Since 1995 it has also been inscribed as a UNESCO World Heritage site.

Following a short wait and a bit more photography in the Big Room I went off to join one of the Ranger-led adventure tours of Spider Cave. This was an altogether different experience to the very easy, paved caves I had been in earlier. Our Ranger opened up a small access gate and after checking for rattlesnakes inside, we followed her in through a five-metre-long squeeze that was only an inch or two taller than I am lying down.

Once I was through it opened out a little more, but it remained a good muddy scramble throughout and I was certainly glad I brought knee pads. Some of the formations inside Spider Cave were absolutely fantastic with some really pretty aragonite bushes being among the highlights. You are not allowed bags or tripods on this tour so regrettably I wasn't able to take photos.

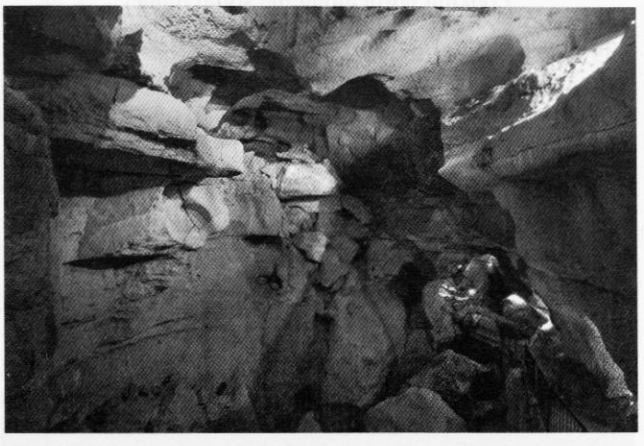
Before going on the tour I felt this was being a little tough, but having been inside I can understand that they are just protecting the formations. It would be all too easy for a rucksack or a tripod leg to accidentally break a straw or crush an aragonite bush. We spent three hours moving through the cave – unlike many caves it was very warm and humid in there, and by the time I emerged into the bright sunlight at the end I was covered in mud, but very happy.

Sonora's paradise

Day eight was supposed to be a driving-only day. It was a five-hour drive from Carlsbad to my next destination, Sonora across the border in Texas.

The roads in this part of the US tend to be straight and very sparsely populated. I found the long drives a lot easier than motorway driving in the UK because there really is very little to do once the cruise control is engaged apart from keeping one's eyes open, wits engaged and listening to a good audio book. I arrived at my hotel slightly early and as arranged I telephoned the Caverns of Sonora[10] to let them know I'd be there the next day for my photographic tour.

They suggested to me that with an hour to go until the last tour of the day I really ought to head over and get a recce done so I could maximise the three hours I had available the next day. Never being one to turn down time underground I immediately drove on for another twenty minutes until I reached the site. The tour started out in the same way as other cave tours, and I was pretty much expecting to just see more of the same. Locals first started exploring the cave in the 1920s but after 500 feet they found it ended in a very deep pit, known as 'The Devil's Pit'. This section of the cave was originally known as Mayfield Cave



The Devil's Pit today

In 1955 three speleologists started to explore the cave and spotted passages on the far side, but being short of time they had to leave before they could make their way across to them. A fortnight later on Labour Day weekend four other cavers made the perilous climb across the side of the pit and ventured down into the deeper parts of the cave. Their stories of strange formations spread and in 1959 development of the cave began, culminating in the public opening in 1960.

As we walked through the cave and entered 'the first pretty room', I realised that this was no ordinary cave and that I was in for something special. Just about every surface from that point was covered in calcite crystal formations; making it undoubtedly the most beautiful cave that I have ever seen. Delicate crystals hung from every available surface, crystal covered columns built up from the floor and crazy, wiggly helictites grew out of the walls. The cave is a hot and very humid one, and I was actually glad to get outside at the end of my recce!

My photographic tour of the Caverns of Sonora on day nine went very well indeed – three hours was just about the right length of time to capture all the formations and I was pleased with the results I got. Afterwards I started the three-hour journey to the Texas state capital, Austin.

The next three days were spent visiting friends and doing non-underground things, but I rounded off my trip with an adventure tour at Inner Space Cavern[11] on day twelve.

It was discovered in 1963 by a work-crew drilling as part of the Interstate 35 construction project. When they realised the drill had penetrated an empty space, a worker was lowered down, clinging onto the drill to see what they'd broken into. The cavern was opened to the public in 1966.

There is evidence of prehistoric animals finding their way into the caves with bones of mammoths and sabre-toothed tigers being found in the cavern. The tour was definitely off the beaten track in the cave with plenty of tight spaces to go through (including one which was smaller than me and required some real squeezing). I wasn't able to take my camera on the adventure tour and given the muddy state I came out in, I am very glad I didn't take it with me.

As always with trips like this, every site I visited yielded more leaflets and suggestions of other underground sites to visit. I believe I've already built up almost enough caves to cover another two-week trip next year!

(1) www.admmr.state.az.us/General/museum.html
(2) www.hallofflame.org/
(3) www.titanmissilemuseum.org/
(4) www.titan2handbook.com/
(5) www.asarco.com/AMDC/mine_tours.html
(6) www.pimaair.org/
(7) www.queenminetour.com/
(8) www.nps.gov/whsa/
(9) www.nps.gov/cave/
(10) www.cavernsofsonora.com
(11) www.myinnerspacecavern.com/

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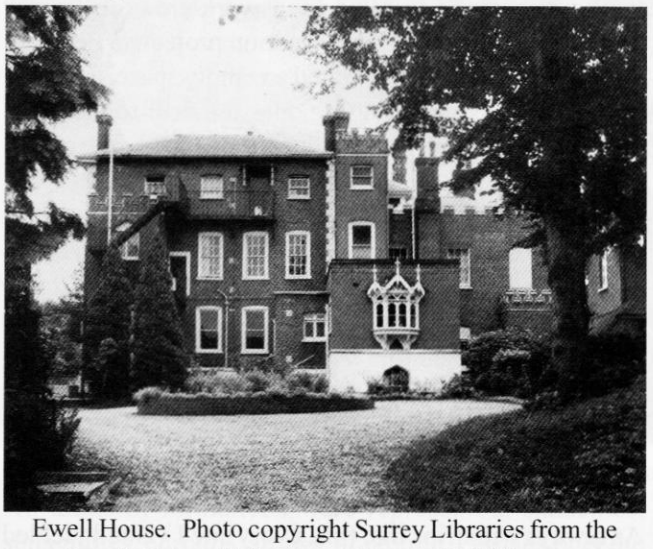
All pictures by Gavin Saxby.

Ewell House Tunnels, Surrey

By Nick Catford

Ewell House was built in the late 17th or early 18th century and much altered in later years. It was located in Ewell village in Surrey with its main entrance on Epsom Road. A network of tunnels was excavated under the house and grounds, probably at the same time that the house was built. The earliest date noted carved into the walls is 1781 which could be the date of construction of the tunnels or it might have been added when the tunnels were adapted for later uses.



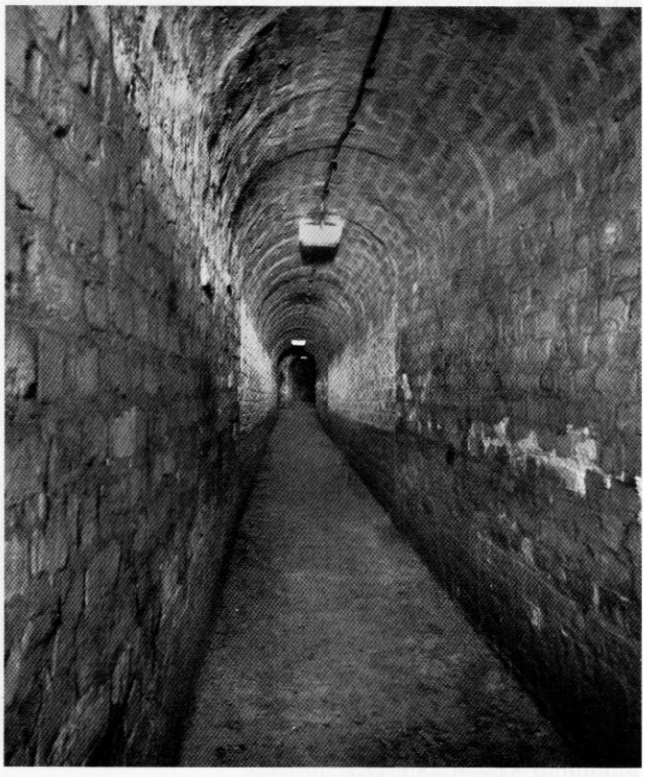
Ewell House. Photo copyright Surrey Libraries from the Local History Collection at Bourne Hall Museum

The geology of the area comprises Reading Beds under Thanet Sand and Upper Chalk. The tunnels are cut through a brown-grey slightly silty fine to medium sand. The exact purpose of the tunnels is unknown but during the 19th century it was common practice for the lower classes and tradesmen to be kept out of sight of the upper classes. Servants were not permitted to sully the view from the front of the house and might have been required to enter the house and grounds through tunnels which would have brought them directly into the servants' quarters. Many houses also had their kitchens in separate buildings (to reduce the fire risk) and tunnels were used to connect these to the main house.

Tunnels are known at other large houses, notably Petworth House in Sussex and locally at Woodcote Grove in Ashley Road, Epsom which was also built in the late 17th century. Here a brick-lined tunnel running from the cellar to the garden and another tunnel running from the road to the house are recorded. Thus the Ewell House tunnels were probably originally built as a servants' entrance but were later adapted for other uses, with part of the network being used as an air-raid shelter for Ewell House during World War II.

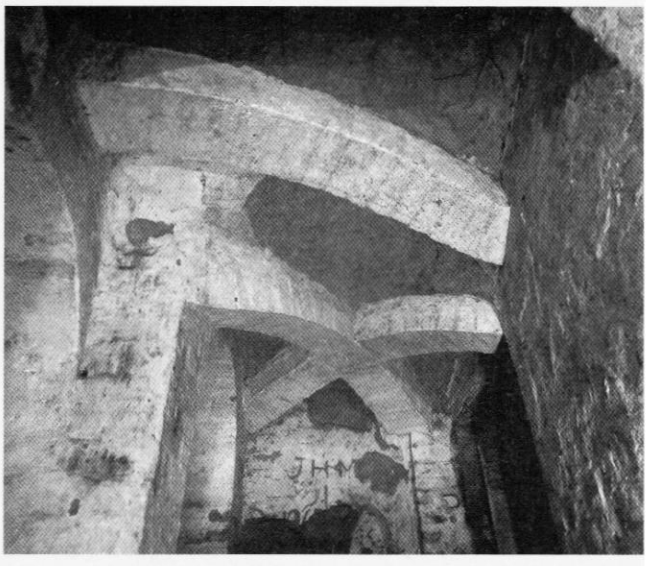
The tunnel network

The tunnel network comprises four tunnels of different length intersecting at approximately right angles beneath the summer house in the grounds of Ewell House. The

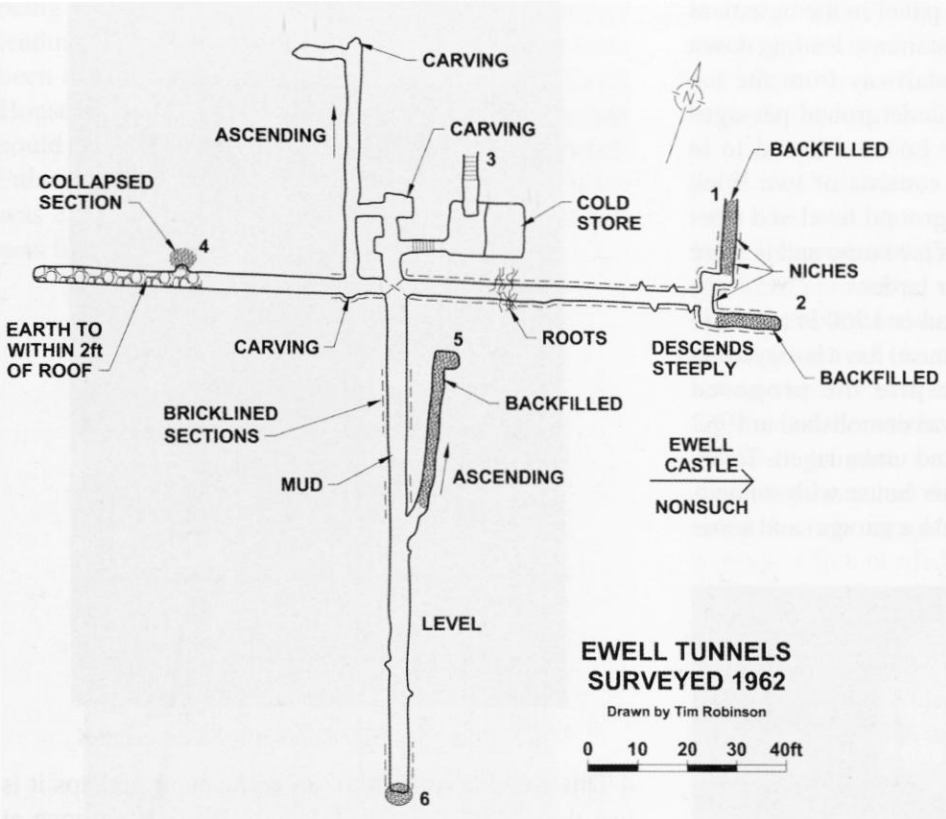


Looking north along the south tunnel

tunnel system is dug in weakly cemented sandstone and appears to have been dug using hand tools. In general the tunnels are about 1.8 metres high and one metre wide. The strength of the sandstone is sufficiently low for the rock to be easily excavated and trimmed by hand and as such the unlined sections of the tunnel wall have been carefully smoothed over obliterating any tool marks. The ease in which the tunnels were excavated can be seen in some of the deeply carved graffiti along the tunnel walls. In most places, the tunnel has a pitched roof with vertical walls and a loose sand floor. The tunnels are generally horizontal apart from the southern tunnel which is inclined downwards for a short distance from the main

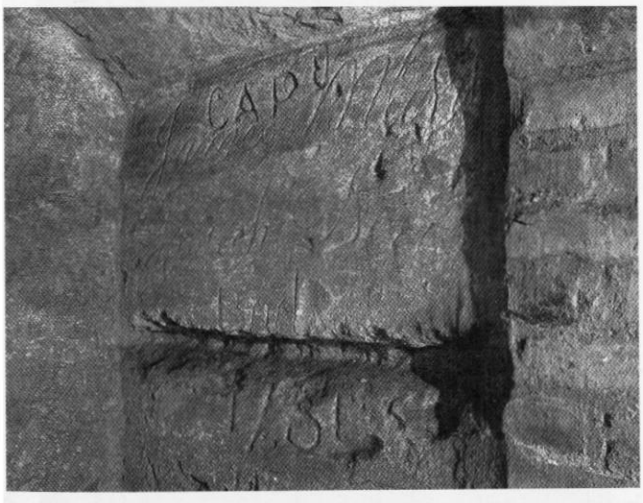


Vaulted buttressing under Ewell House



intersection. The east passage is brick-lined throughout to a very high quality with vaulted brick buttressing at passage intersections. Much of the southern tunnel, which is approximately three to four metres below ground, is also brick lined.

Originally the tunnels were lit by candles placed in small niches cut into the walls. These are so placed that the illumination from one candle reached that of the next providing illumination throughout the tunnels. Soot marks are still visible in these niches. Later, gas lighting was installed in the first ten metres of tunnel from entrance 1



Graffiti dated 1781

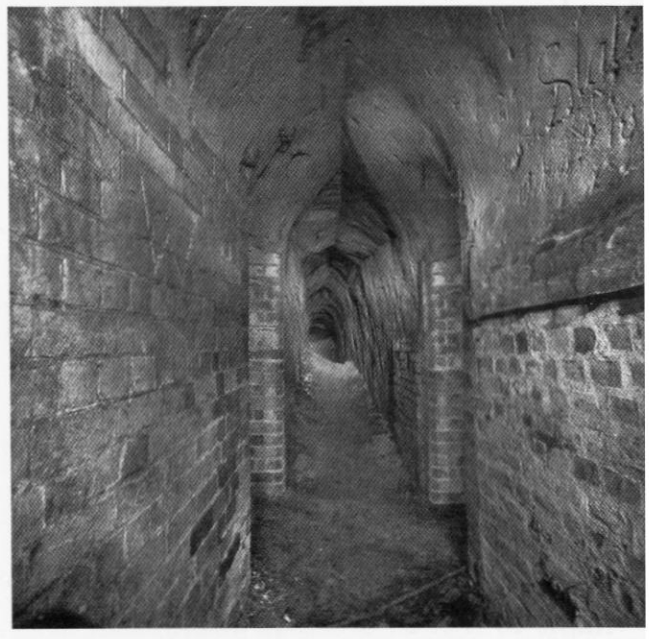
(see plan). There are also remains of temporary electric lighting in the tunnels directly under Ewell House which were used as an air-raid shelter during World War II. At this time three brick walls were built across the east passage to prevent access from the adjacent property but these have now been breached.

Many of the lighting niches are edged with cork and a possible ecclesiastical connection has been suggested. There is extensive graffiti throughout the tunnels, much of it dating from the end of the 19th century but after the early 1900s there is little graffiti until the middle of the 20th century when there are many inscribed dates suggesting that the tunnels might have been unofficially open during this period.

Redevelopment and recording

In the early 1930s, the gardens of Ewell House were split up and sold for redevelopment and the summer house with its underground cold store and access to the tunnels was included in one of the plots; a new house was subsequently built on the land. Where the house stands above the tunnels they were reinforced at crucial places with brick arches and pillars although through access was maintained. Some of the other entrances were probably also filled in at this time to allow for building.

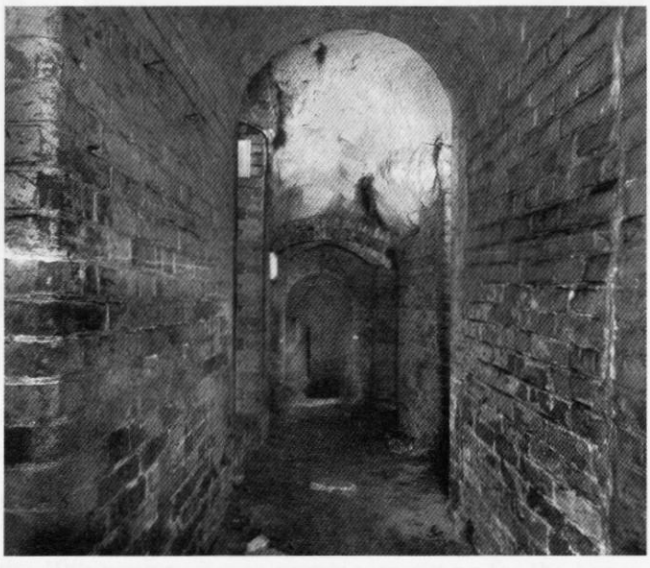
The first documentary evidence of tunnels at Ewell House is dated as late as 1959 and relates to a preservation order proposed for the house although it doesn't specify if the tunnels were to be included. A report submitted as



Looking west along the west tunnel from the main tunnel intersection beneath the summer house. Note the earth that has slumped into the tunnel from entrance 4.

part of the application states: "A panel in the basement of Ewell House gives access to a staircase leading down to underground passages.... A stairway from the ice house leads down to a series of underground passages and artificial caverns." The ice house referred to is beneath the summer house and consists of two brick vaulted rooms a few feet below ground level and does not resemble any known design of ice house and is more likely to have been a cold store or larder.

The Daily Telegraph on 26 November 1960 in a feature on Ewell House says "It (Ewell House) has a honeycomb of underground tunnels". Despite the proposed preservation order, Ewell House was demolished in 1962 but the tunnels remained intact and undamaged. Today only the brick timber-lined summer house with stained-glass windows (now converted into a garage) and some of the perimeter wall survives.



Looking south from the main intersection beneath the summer house. To the left steps lead up to the cold store, the start of the west tunnel is seen on the right.

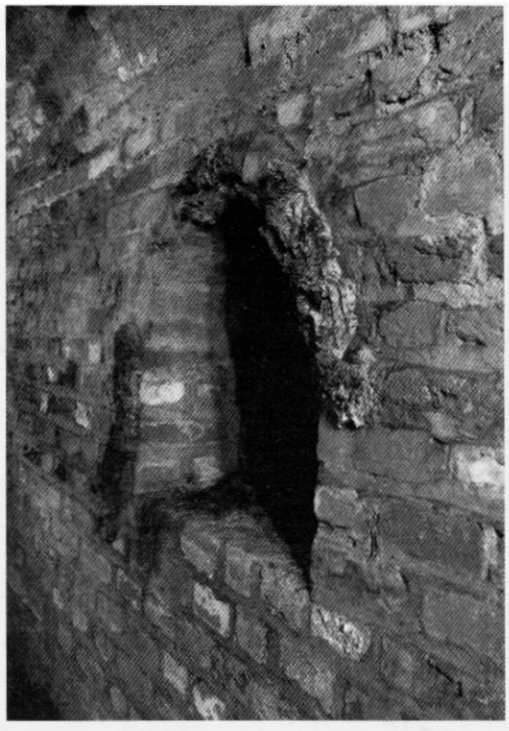
Ins and outs

When surveyed by the Chelsea Speleological Society in 1962 six possible entrances or former entrances (numbered 1 – 6 on the plan) were noted as follows:

1 The main entrance from Ewell House - it leads down a short flight of steps from what was the basement of the house, along a passage brick-lined with many recesses that have now been identified as probable wine bins. This entrance was open in 1962 but was lost when a block of flats was subsequently built on the site. There is now no evidence of the steps underground.

2 This entrance passage descends very steeply dropping 2.5 metres; the courses of brickwork sloped down with the gradient, and then it seems to level out, only to be blocked either by a roof fall or by rubble that has been thrown down the slope. This sloping tunnel is now also under the new flats and has been lost.

3 Leads down a long flight of steps from the cold store, which in turn is several steps below ground level. This is now the only entrance that is still accessible.



One of the cork-edged niches used for candles

4 This could be the site of an entrance or perhaps it is just the site of a collapse. It has clearly been open at some time as there is a large quantity of earth along the west passage that has evidently come in through this opening. This has now been paved over,

5 From the ascending gradient of the passage this too was an entrance that has been filled in from above. When it rains a large volume of water comes in here and collects on the floor of the south tunnel. This entrance was probably in the garden of Ewell House by the garden gate, where there was a mound, though according to one rumour it rose in the cellar of one of the houses in Ewell House Grove.

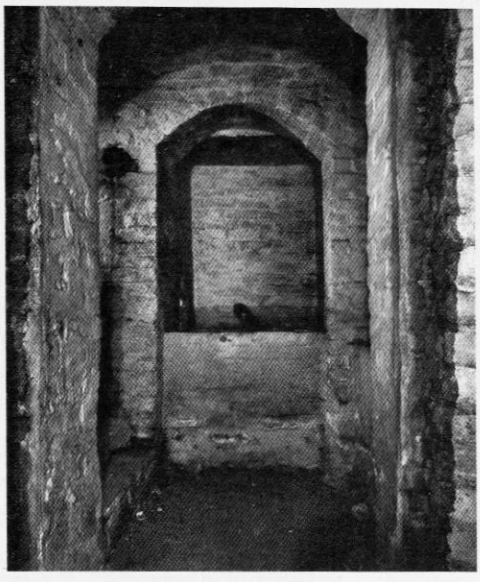
6 The tunnel at the end of the south passage has been blocked by a fall; it is not certain if there was an entrance at this point or if the tunnel led to an entrance elsewhere. There is some documentary evidence that this tunnel surfaced on the far (east) side of Epsom Road.

Speculation and stability

The CSS report also speculates about possible extensions to the tunnel network. These were based on local legend and rumour. Both Epsom Downs (1˚ miles) and Hampton Court (5˚ miles) can quickly be discounted. The only credible extension from entrance 2 was to Ewell Castle, a distance of 400 yards although later surveys indicate that an extension to Ewell Castle is unlikely but not impossible.

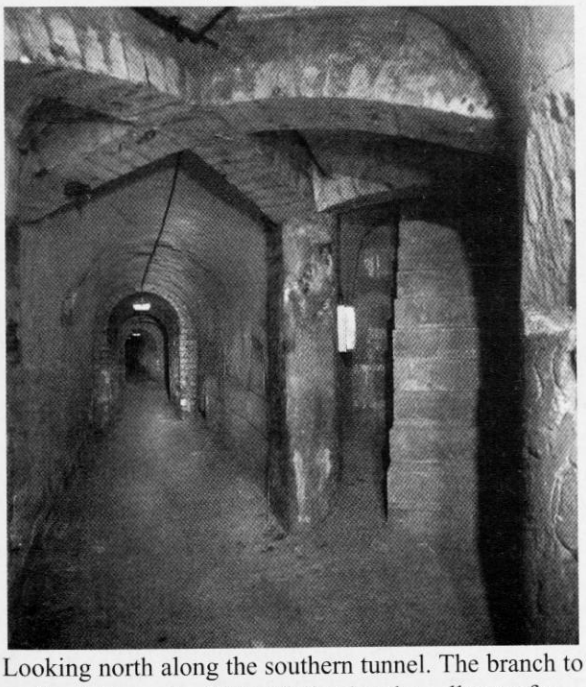
The Castle was built in 1812 on the site of a much older house, the cellars of which still remain. In the corner of the front garden nearest Ewell House and about 25 feet from Ewell Castle is a flight of steps descending into the ground in the direction of Ewell House; these are now blocked with earth after three or four steps. The Principal of Ewell Castle School stated that when Glyn Close was

being built (mid 1930s) signs were found of a passage leading to this part of the grounds, this could just have been the final destination of the east passage at Ewell House. It has also been suggested that the east passage could have extended a further 600 yards to Nonsuch Palace but this can now be discounted as the Palace was excavated in 1959/60 and no evidence of tunnels was found.



Below Ewell House

In 1997 the tunnels were inspected by Subterranea Britannica and the Surrey Industrial History Group as part of a historical study being undertaken by Surrey County Council's Planning, Archaeological and Historic Landscape Group; at this time a full photographic survey was made by the author. The report by the Surrey Industrial History Group suggested that the southern and eastern arms of the system may be earlier than the north and west arms which appear to have been less carefully excavated or lined. The latter are simply cut into sand and appear to have had no specific function, perhaps being excavated 'for fun' as a folly. There are a number of rough wall carvings in this area.



Looking north along the southern tunnel. The branch to the right was backfilled following the collapse of a soakaway in 2001. Vaulted buttressing is seen at many of the tunnel intersections

Following subsidence in one of the adjacent gardens in 1998 a full stability survey was carried out by a consultant from Imperial College (Royal School of Mines) with specialist knowledge of tunnels and mines in weak rock. The report indicated that the tunnels were generally stable but highlighted areas where instability had caused collapses in the past, some of which had migrated to the surface. In the southern tunnel in particular there was evidence of past water ingress when water from a soakaway breached the tunnel. Some water was found in the branch tunnel running north from the southern passage which needed to be rectified immediately with annual inspections thereafter. The report also recognised the historical importance of the tunnels.

The mining engineer's fears came to fruition in 2001 when a soakaway collapsed into the branch tunnel running north from the south tunnel. This was subsequently filled with concrete to its junction with the south tunnel with the loss of approximately nine metres of passage. Since then there have been a number of minor falls attributed to tree roots but the tunnels remain dry and stable. The current owner does not allow access.

Sources:

The Tunnel System beneath Ewell House. A survey and inspection report commissioned by Surrey County Council. 3.3.1998

Chelsea Speleological Society Records Volume 3 Secret Tunnels in Surrey. 1963

Report to Surrey County Council Planning Department from Malcolm Tadd, Secretary, Subterranea Britannica. March 1997

Notes on the tunnel network by George Threadgold, owner of the summer house in 1997.

Photos by Nick Catford unless stated.

Subterranea Britannica Visits weekend : Sweden

From May 6th to 9th 2011 we will be running a Sub Brit trip to Stockholm, with arrangements by one of our local members, Lars Hansson.

For more details and to reserve a place on the trip, please see the Flyer enclosed in this edition of *Subterranea;* or email info@subbrit.org.uk

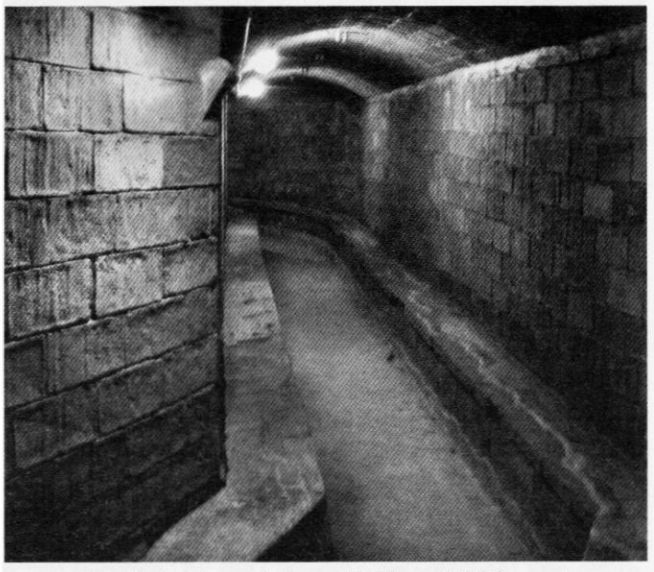
Spanish Civil War air-raid shelters in Barcelona

By Gabriel Moshenska

Introduction

In December 2009 the Museu d'Història de Barcelona organized a three-day conference entitled *Air Raid Shelters of Barcelona: Heritage Intervention Criteria*. The aim of this conference was to carry out consultation towards creating a policy on the study, recording and preservation of around 1,400 air-raid shelters from the Spanish Civil War era that remain under the streets of the city.

In the course of the conference we visited several air-raid shelter complexes, all of them subterranean tunnels with galleries. One of these is open to the public as a heritage site, one is managed on a restricted-access basis by a community group, and one, most excitingly, was only recently discovered during the building of an underground car-park and has not yet been surveyed or cleared. In this short article I outline the historical background and current state of these air-raid shelters.



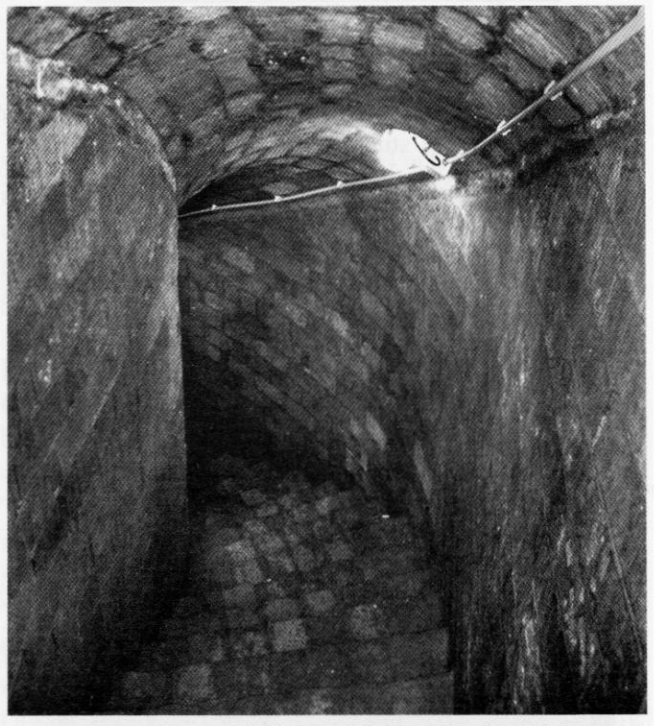
The shelter tunnels beneath Plaça del Diamant.

Background

The Spanish Civil War (1936-9) is famous in the history of air warfare for the bombing of Guernica, with the ensuing international outrage and Picasso's iconic artistic response. However, for contemporary Britain it was the bombing of Barcelona that caught the popular imagination.

For a start, unlike Guernica, Barcelona was a modern metropolitan city, the first to come under sustained aerial bombardment since the First World War. In addition, the Government of Barcelona had put into place a number of measures, including the construction of air-raid shelters, that were of intense interest to British and other overseas observers seeking to monitor their efficacy, and to modify their own civil defence accordingly. The most famous of these was the scientist J.B.S. Haldane, who visited Barcelona several times on behalf of the Communist Party of Great Britain, and wrote a book called *A.R.P.* (Air-Raid Precautions) based on his conclusions. Civil engineer Cyril Helsby visited the city on behalf of the Labour Party, and his report in 1939 to the Institute of Structural Engineers gives an excellent illustrated account of his findings. He found that "In regard to A.R.P., Barcelona has achieved a remarkable measure of success."

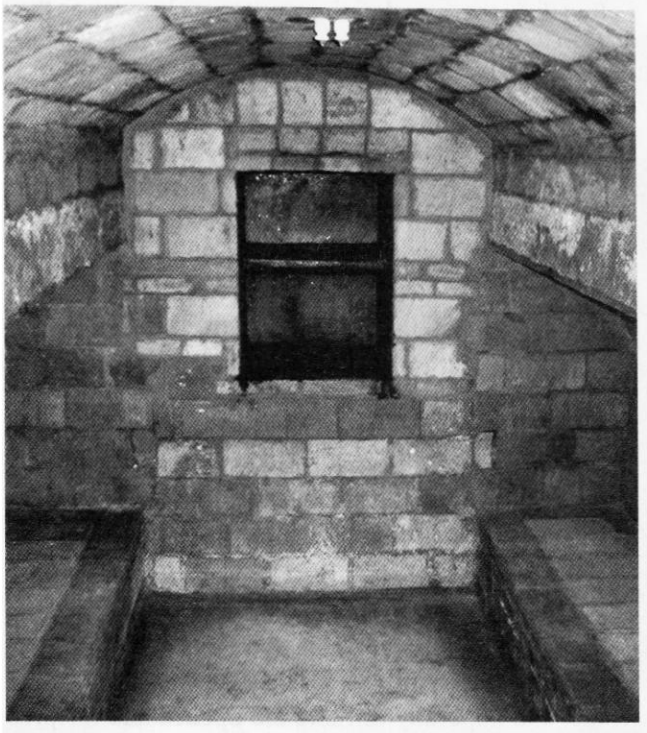
Both Haldane and Helsby were astounded by the amount and quality of air-raid shelters in Barcelona. To understand why, we need to compare the numbers built by the government of Barcelona – around thirty – with the numbers built by the people of Barcelona, who were organized into work gangs in workplaces, apartment buildings and squares and dug where they stood. More than thirteen hundred shelters were built in this fashion, predominantly by women and elderly people, as the men were mostly fighting on the front lines to the south of Barcelona. Work was coordinated by the newly created *Passive Defence Board of Catalonia* through its local offices.



Staircase at Plaça del Diamant shelter showing elaborate brickwork

These popular shelters were in the form of mine galleries below the street, dug around eight metres into the sandstone geology. The corridors were between 1.8 and 2.2 metres high and between 1.4 and 1.6 metres wide (Powles 2003). They had toilets, electric lights, telephones and first-aid stations, and many of the larger ones had dedicated crèches and dispensaries. Smoking and firearms were banned in the shelters, and for the sake of harmony many displayed signs banning the discussion of

religion or politics. The walls of most shelters were lined with earthenware tiles, though some had white-glazed tiles to facilitate cleaning and to maintain levels of hygiene in what could have been a breeding ground for epidemics.

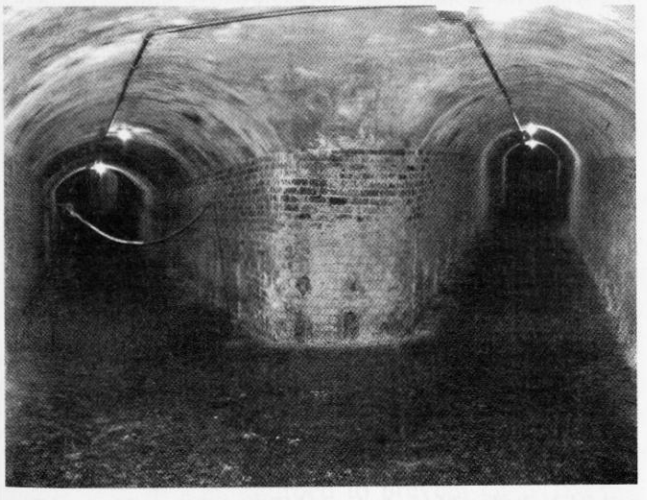


The infirmary in shelter beneath Plaça del Diamant

From March 1937 Barcelona came under regular attack from the air. The Italian Air Force established a base in Majorca, from which it flew a total of 194 bombing raids on the city before the cessation of hostilities. The casualties numbered around 2,500, with about 1,500 buildings in the city being destroyed. No doubt casualty numbers would have been much higher without the large number of deep, bomb-proof shelters beneath the streets of the city.

Conference December 2009

The conference included delegates from Britain and Germany, military historians, state and regional archaeologists, conservators and politicians. The papers considered (1) the history of the air war in Barcelona; (2) the surviving traces in the city; (3) questions of what to preserve, and (4) comparisons from abroad. In this last category I provided an account of the development of ARP in Britain, particularly the controversial deep-shelter schemes, and the influence of the Barcelona model on British policy-makers, which the Catalan historians had not hitherto been aware of.

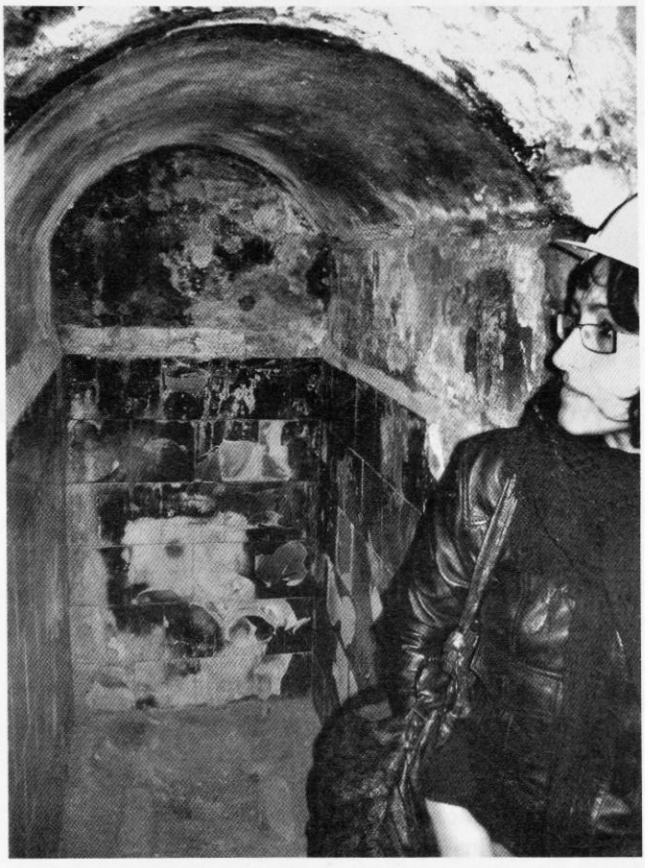


The interior of El Refugi 307

One recurring phrase in discussions of ARP in 1930s' Britain was the need to become "Barcelona minded" with regard to shelter construction – in other words, to take it seriously (Helsby 1939). The final part of the conference was devoted to creating a *protocol for intervention*, and included touring air-raid shelters in the city.

El Refugi 307

Built into a hillside behind what was, at the time, a glass factory, Refugi 307 consists of 200 metres of tunnel dug into solid rock with three access points spread along its length. Today Refugi 307 is a heritage site open to the public, with multi-lingual information panels providing a great deal of information about the Civil War, the bombing and the construction of the shelter. The guidebook, which includes a summary in English, contains a number of striking images, including a series of beautiful 1930s Art Deco posters that were used to recruit people to come and dig shelters.



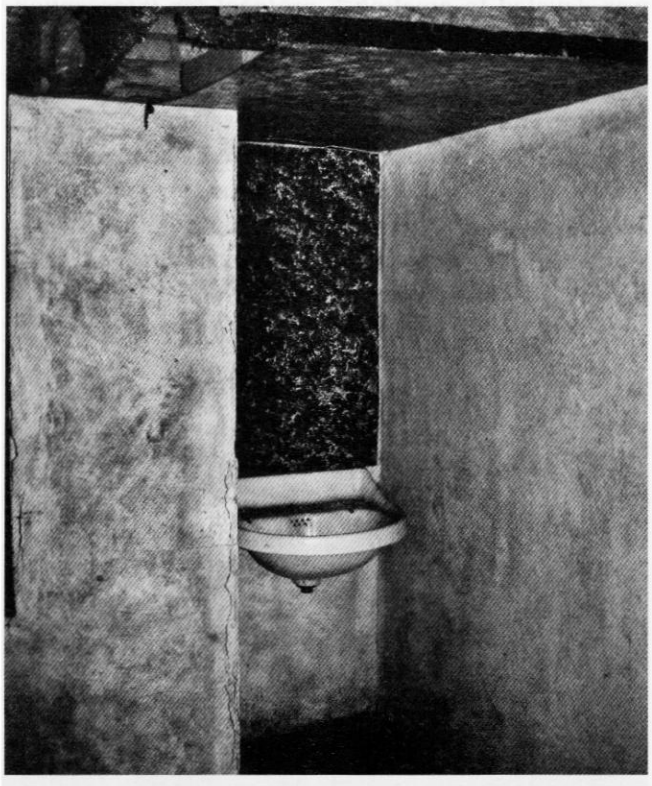
Toilet cubicle in El Refugi 307

Plaça del Diamant

The shelter beneath the Plaça del Diamant is the remainder of a much larger network of tunnels in this

part of the city. The two entrances to the shelter have been covered with secure steel and glass stairwells, erected by a local community heritage group, who arrange and restrict visits to the site to prevent the build-up of moisture and condensation in the tunnels. The shelter is reached by a tiled spiral stairwell, and is made up of galleries and smaller rooms off the main tunnels. This shelter is well preserved, and traces of painted numbers can be seen where seats have been reserved for designated numbered ticket-holders – a common system in Barcelona at the time.

Underground Car Park



Marble interior of bathroom in car park shelter

The most remarkable site we visited was accessed from a small door in the corner of a vast underground car-park, three flights of stairs down from street level. In the construction of this car-park engineers had been mystified to find their concrete draining mysteriously away as they poured it. They found that some of their reinforcing bars had broken into a hitherto undiscovered shelter beneath the wide boulevard.

Despite being in good condition it is still unclear from where the shelter was originally accessed, as the staircases have been sealed up from the top. The shelter is made up of galleries and rooms like the other two. It is plastered rather than tiled in most areas, and includes such luxurious surprises as black marble splash-backs to the wash basins in the bathroom. The electrical wiring has come loose and hangs in the corridor, making it difficult to explore some areas, and the bench seats built into the walls make it more difficult still. The floor at the time of our visit was still covered in gravel, scrap and pieces of ceramic insulation from the electrical wiring.

Conclusion

The air-raid shelters of Barcelona are a vast and exciting resource that has only begun to be explored. The few sites that are currently accessible are fascinating and iconic, and hopefully as more are opened and restored they will become a must-see for underground-minded people visiting the city.

All Photos by Gabriel Moshenska

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Work of the Geological Survey in World War II – the Wartime Pamphlets Series

During World War II the Geological Survey of Great Britain published a series of *Wartime Pamphlets*, the result in part of attempts to find native mineral resources to replaced materials difficult or impossible to import during hostilities. There was a similar exercise, and series of reports, in World War I. Whilst many of the *Pamphlets* deal with water-supply, and were effectively republished in the *Well Catalogues* series, others examined the feasibility of mining or opencast working of minerals including barytes, chromite, diatomite, dolomite, feldspars, iron ores, mica, phosphates, refractories, and even peat. There was, certainly in World War I, a desperate search for very pure silica sands, essential for the manufacture of very high quality optical glass for use in binoculars and periscopes. During hostilities, this could not be imported from Belgium or France, hitherto a main source of supply. The United Kingdom's last working silver-sand mine, at Loch Aline on the mainland Scottish coast opposite the north coast of the Isle of Mull, owes its origin to this search.

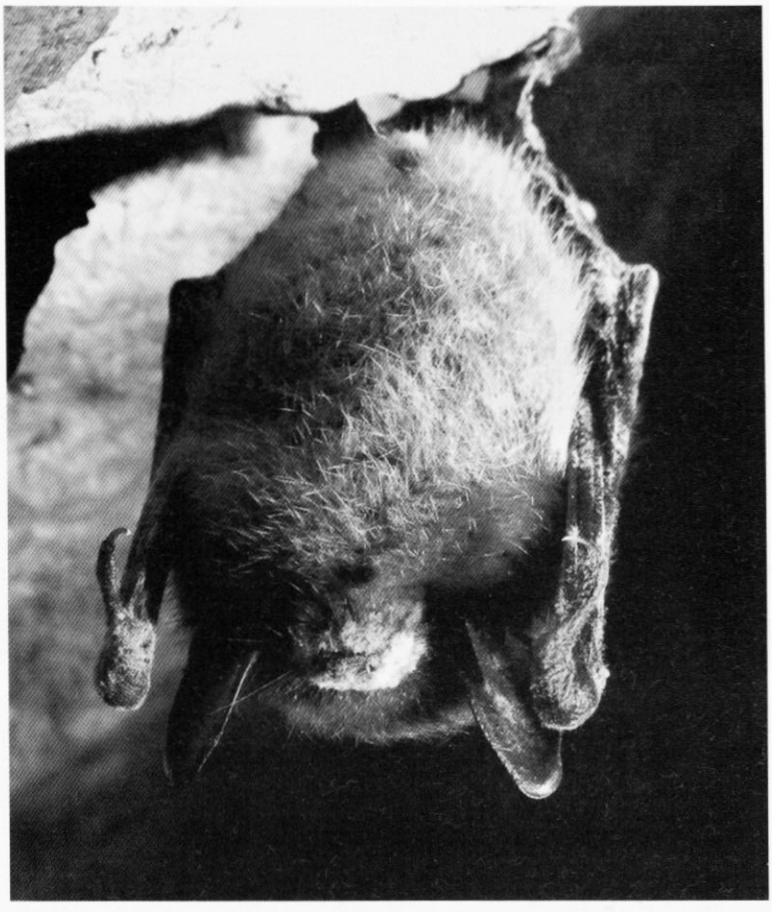
The search for economically workable native mineral pigments such as ochres and umbers was perhaps related to camouflage requirements. A somewhat recherché material researched was glauconite (a potassium aluminium iron silicate), a dull green earthy mineral found in some marine strata in southeast England, and elsewhere. The relevant *Pamphlet*, published in 1943, examined the possible uses of glauconite (from the Bracklesham Beds of the London Basin) as a source of potash, as an agricultural fertiliser, as a pigment, as a water-softener, and for the 'humanization' of milk (rendering cow's milk more like human milk, and thus more suitable for infants and invalids). So far as I am aware, this material was never in fact exploited or used for any of these purposes.

During the last year or two of World War II the *Wartime Pamphlets* were overprinted with the stern warning 'This document is CONFIDENTIAL, and should be kept under LOCK and KEY. It should be destroyed if there is any danger of its falling into the hands of enemy agents'.

White-Nose Syndrome – a threat to European bats?

Important advice for all who venture underground.

By John Altringham



Since its discovery and diagnosis in 2006, White-Nose Syndrome (WNS) has killed over one million bats of at least seven species in hibernation sites in the northeastern USA and Canada. Each year it spreads to new caves and mines.

The syndrome is characterised by a fungus that forms a conspicuous growth on the face, ears and wings. Infected bats are typically thin, suggesting that they don't have the food reserves to survive the winter. As a consequence, the floors of hibernation roosts have been observed littered with dead bats: from 30–99 percent of the hibernating population can be lost at a site in a single season.

The cold-loving fungus has been isolated and named *Geomyces destructans*. It is not yet clear whether the fungus is a symptom of the disease or its primary cause, but the absence of any other disease vectors suggests it is the cause of death.

European researchers have now isolated the same fungus from hibernating bats in France, Germany, Switzerland and Hungary, with (as yet unconfirmed) reports coming in from other countries. However, in Europe, the fungus does not appear to be associated with mass death. Why the difference? One possibility is that the fungus has always been present in Europe. If this is the case, bats and fungus would have evolved together and bats could therefore be resistant to it.

The disease first came to light in the USA at a show-cave in New York state. Did it arrive on a human carrier from outside North America, with devastating effects on bats that had no defence against it? An alternative explanation is that the fungus has long been present in North America but has mutated into a more virulent form. If so, is there a risk of the introduction of this form into Europe? The third possibility is that *G. destructans* has only just arrived in Europe and we have yet to witness the damage it can do. This is perhaps the least likely explanation, since the evidence suggests it is already widespread in Europe and in the US it struck with incredible rapidity.

G. destructans has not yet been found in the UK. While we wait for the results of further research, what should underground explorers do?

Until there is evidence that *G. destructans* in Europe leads to WNS we simply have to be alert. The current Conservation Code advice still stands; hibernating bats should be left undisturbed to prevent early waking. However if, in the course of your normal underground activities, you see a hibernating or dead bat with a fungal growth on the face, ears or wings, leave the bat untouched, make a note of its location and report the find to the Bat Conservation Trust (phone 0845 1300 228 or go to http://www.bats.org.uk/bat_help.php).

A photograph can be useful, but only take a picture if there are visible symptoms and you can do so without disturbing the bat and other bats nearby. A licensed bat worker will then visit to take samples where possible.

The hope is that European bats have indeed evolved with *G. destructans* and have defences against it – and WNS will not become a concern in Europe. However, as long as the jury is out we have to be cautious: any danger signs must be spotted early. As well as protecting the health of bats this should allow responsible underground visits to continue. It would also be helpful if all those venturing underground would keep their gear as clean as possible to prevent any possible cross-contamination.

This article has arisen from discussions between the British Caving Association, British Cave Research Association, Subterranea Britannica, the Bat Conservation Trust and the Statutory Nature Conservation Organisations for England, Scotland and Wales.